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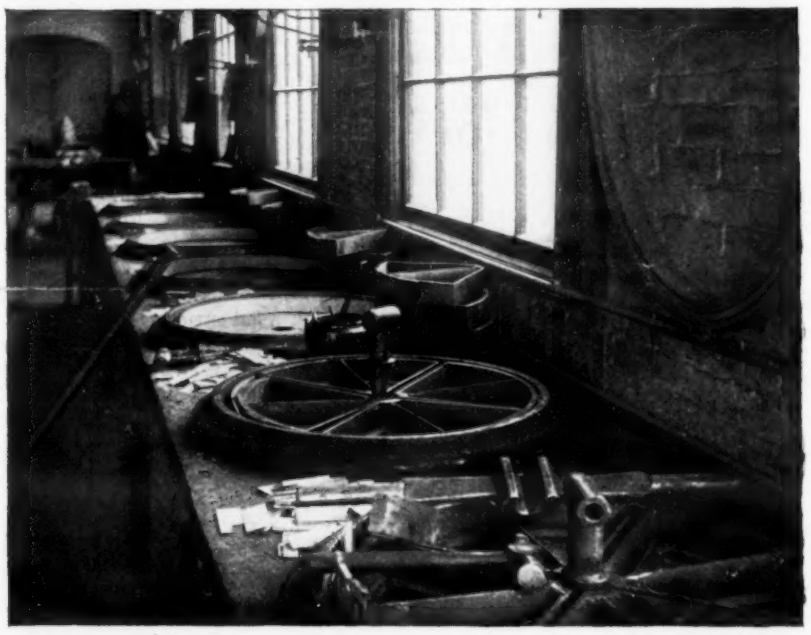
Bicycle Tools—I.

The great popularity of the bicycle, its large sales during this season of 1895, and the present great activity in enlarging and improving existing bicycle manufactories, and the putting down of new plants for the production of the "winged wheel," makes all accurate information as to tools and methods in successful use in bicycle shops of present interest, not merely because they produce the "silent steed," but because they are at the present time better equipped and present more new practice in the various lines of small metal manufacture than any other shops. There was a time when



RIM-GLUEING TOOLS.—FIG. 1.

here in America the armories at Springfield and Ilion and Hartford were immeasurably in advance in tools and methods for small work; later, the sewing machine manufactories carried the art a long step beyond the armories, and now the bicycle shops take the lead in point of small-tool designing and operation.

In April last the AMERICAN MACHINIST decided to give extended notice to the means and methods of the bicycle shops, and it was supposed that careful notes and abundant photographs from six or eight well-known factories would cover all that was of real interest in the field, and that a few weeks of well-directed industry would put the matter in form to begin the publication of a really full series of articles under the heading of "Bicycle Tools." The weeks passed, many factories were visited, examined, photographed and discussed; each one was found to possess features of interest differing from all the others; and the weeks lengthened into months before the task was sufficiently complete to make it possible to begin a coherent and even tolerably well-arranged detail of the practice of American bicycle factories. Some of these establishments, like the "Warwick," were found to be based entirely on the armory practice; some, like the "Western wheel," on the German locksmith foundation, and others, like the "St. Nicholas," have worked on shops have afforded a most interesting field of observation, and their practice cannot fail to interest all makers of small metal work. So great is the activity at present among makers of light machine tools in the way of new designs for bicycle work, that had this series of papers been begun in June last, as was intended, they would now be somewhat behind the times, and to reach anything approaching completeness they will require supplementing with later observations even now.

After careful consideration it has been decided to take each part of the bicycle and present the different tools and methods employed in the production of that piece in different shops, with, in all cases where obtainable, such records of machine performance as will be of interest to superintendents and foremen of bicycle factories and other light metal manufacturing shops. If each factory were to be considered separately, it would be very difficult to make the comparisons of tools for performing the same operations. In some cases, however, where the shops are based on entirely different methods, as, for instance, the "Warwick" and the "Columbia," which embody the New England armory and sewing machine factory practice, and the "Western wheel," which is distinctly in the German locksmithing spirit, a shop comparison is extremely interesting.

Most of the cycle shops opened their doors cordially for the purposes of inspection, generally, however, with some reservations, and sincere thanks are hereby tendered to all who have so kindly assisted in obtaining the information contained in this series of papers.

Some of the shops reserved some processes, in most cases of a wholly unimportant character, and others, and among them several of the largest concerns in the cycle way, gave unrestricted permission to use the camera at will through their entire establishments, so that if this presentation of the art and mystery of making bicycles in American shops should fall short of completeness, it will be from lack of skill on the part of the writer, rather than from lack of material, for which thanks are due, not alone to managers and superintendents, but as well to workmen, who so often and so kindly aided in the production of pictures, and the giving of information, which could not have been had without their cordial assistance.

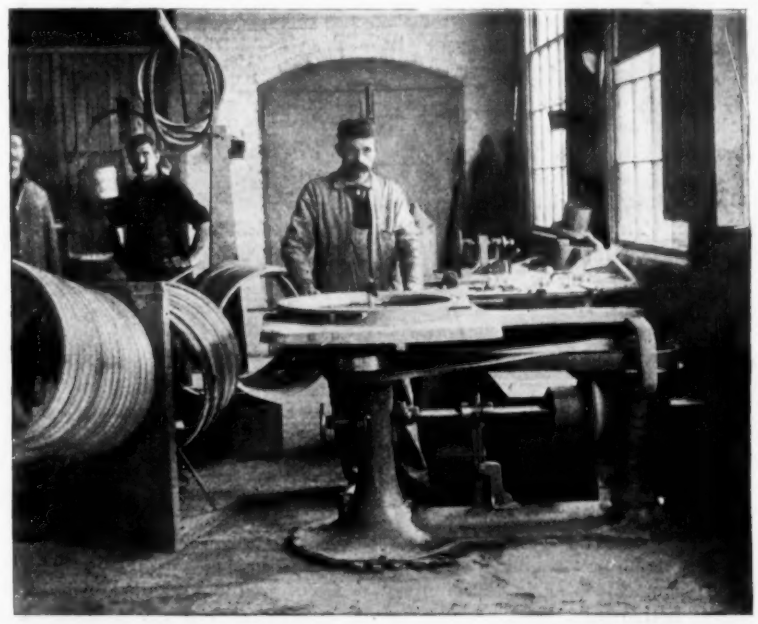
The part selected for first notice is

THE WHEEL RIM.

The "Boneshaker" had a wooden wheel, with wooden spokes, wooden felloes, and an iron tire; in some cases the tire was made of steel, because the metal tires had a way of slipping in case of a quick turn, insuring the rider a fall, in case the corners of the tire were not sharp, and steel tires kept sharp corners much better than iron tires. Then came the solid round rubber tire in a grooved or trough-shaped metal rim, and last, the pneumatic tire, in a grooved wooden rim, made sometimes of one, and sometimes of many pieces of wood, glued together, the wood rim in the early part of the season of 1895 almost wholly displacing the metal rim of equal or slightly greater weight, so that in some factories the output was as high as 95 and 98 wood rims in the hundred machines sold, and steel rims were made only to order. Later in the season, however, there was quite a decided revival of the steel rim, and some of the largest makers look to see the metal rim again in extensive use. This view is not shared by all makers, however; many manufacturers are unwavering advocates of the wood rim, claiming its superiority at all points; but should there be no more bicycle wheel rims made of steel for the pneumatic tire, it is quite likely that such wheels may find a very extensive use in horse-drawn vehicles, if, indeed, the horse is to be continued in use. But there are undoubted fields for the pneumatic-tired steel rim, and the most approved machines for the production of such rims will be shown, although the present standing of the wood rim in public favor gives it first place here.

Wood rims are made of hard maple, rock elm, hickory and some other woods, maple and elm having the choice, and of the two, elm standing first. There are two distinct methods of making a wood rim, and a great variety of modifications of these two methods are in use.

The first method is to saw the wood into strips of about ¼ inch thick, plane the two sides, steam the planed strips, coil them up with glue inside of a metal ring, and then apply pressure from the inside, which is maintained until the wood and glue are both thoroughly dry, after which the rim is



RIM SHAPING.—FIG. 2.

finished inside and out by methods not alike in any two shops visited. A great many shops buy their wood rims from wood-rim makers; the machines and processes of the Indiana Novelty Mfg. Co., of Plymouth, Indiana, among the largest or perhaps the very largest of the makers of wood rims, have been supplied for use here, and will be given in place. The Indiana Novelty rim is made by the second distinct method, of one single piece of wood, and the St. Nicholas rim is made of one principal piece, and two glued-in joining pieces. There are a vast number of different forms of splices and joinings for the two ends of the wood rims when made with one main piece for the body; many of these are patented, and none will be treated at length here, as it is not the present purpose to institute any comparison of the parts of bicycles themselves; but

only to set forth the different methods and tools used in making such parts.

The "Warwick" shops at Springfield, Mass., are, as might be expected, equipped with standard armory and sewing machine factory tools. The building is excellent, and the workmen are of the class to which we have been taught to look for our mechanical triumphs; the "Warwick" makes its own wood rims on the built-up plan, of rock maple. The stock comes into the place in the form of planks enough thicker than the width of the rim to allow for finishing. This stock is sawed into strips and planed on an ordinary "sticker" to about ¼ inch thickness; the ends are then scarfed by hand, making the scarf 5 or 6 inches long. They are next steamed, and are then coiled and glued in outside cast-iron rings, the natural spring of the wood aiding in keeping the outer coil close up to the inside of the ring, and the scarfed joints coming where they will at random, until the desired thickness is obtained; loose cast-iron sectors are then dropped in place inside of the ring of freshly glued-up wood; these sectors have their inner ends, where they approach their common center, finished to fit a screw shank spreading cone, which screws down into a nut in the iron table on which the rings lie; this nut has some freedom of side motion; hence, as the cone is drawn down by the screw, wedging the sectors out hard against the coil of glued strips, the circle of sectors is, within limits, self-centering, and the wood coil is very efficiently clamped inside the outer metal-retaining ring.

The tools for this operation are quite clearly shown in Fig. 1. Wooden wedges are driven between the sectors and the wood rim where needed, as seen in the filled ring in front. The second ring has the wood ring and sectors in place, and the cone screw just entered in the bottom nut, ready to be turned down quickly with the double-end hand wrench of cast-iron, seen lying on top of the first ring; after the cone screw is turned down as far as possible with the hand wrench, the filling wedges are driven where needed, then the long, round bar, seen leaning against the bench, is passed through the eye of the cone screw, and the final squeeze is given by two men on this bar. Beyond the second ring are seen other rings empty, and the filling sectors piled behind them on the bench, ready for quick use as soon as the glued wood coil is in place in the ring. The glue pot and a cone screw appear just beyond the second ring on the bench. These are expensive tools, and cannot be very rapidly used, and there must be a large stock on hand, as it takes the glued-up wood rims a long time to dry, and the pressure cannot be removed until after the glue has set, and should not be disturbed before the whole job is thoroughly dry. It is absolutely essential that rims made by this "laid-up" method should be driven by the central pressure up to perfect joints; otherwise the rim produced is worthless.

When perfectly dry these rims are finished on a "variety molding machine" shown in Fig. 2. This machine, as is well known, consists of a horizontal table on which the work is moved by the hands of the operator to bring it in contact with cutting heads on vertical spindles; these spindles extend downward below the table and are driven from underneath, the cutting heads alone standing up above the table; the cutting heads have smooth cylindrical work guiding collars next above the top of the table, and the work is guided either by pressing some portion of the work against the guiding collar, and permitting the cutters projecting beyond the collar to act on the work at some point above the collar, or, as is very often the case, the work is placed on a wooden pattern base provided with spurs on top which enter the work a little way and so keep it in place on the pattern, while the pattern is pressed against the guide collars, and in this case the cutters can act over the whole of one of the outer surfaces of the work.

To finish the wooden wheel rim on this machine it is put inside of a metallic ring which fits the outside of the glued-up rim blank, these blanks being of the uniform diameter fixed by the gluing rings as shown in Fig. 1. There are a great many different sizes of wheel rims required, and each size of rim requires a full set of tools, if the system of manufacture adopted makes the outside diameter of the rim the guiding and "spotting" surface for locating the rim during the performance of the various operations thereupon. The cutters are of the proper shape to produce the rounded inner surface of the wheel rim. After the inside of the rim is cut to shape the rim is taken

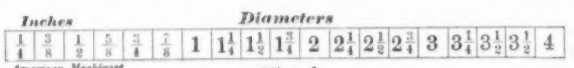


Fig. 1

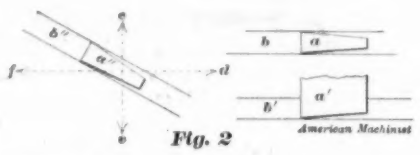
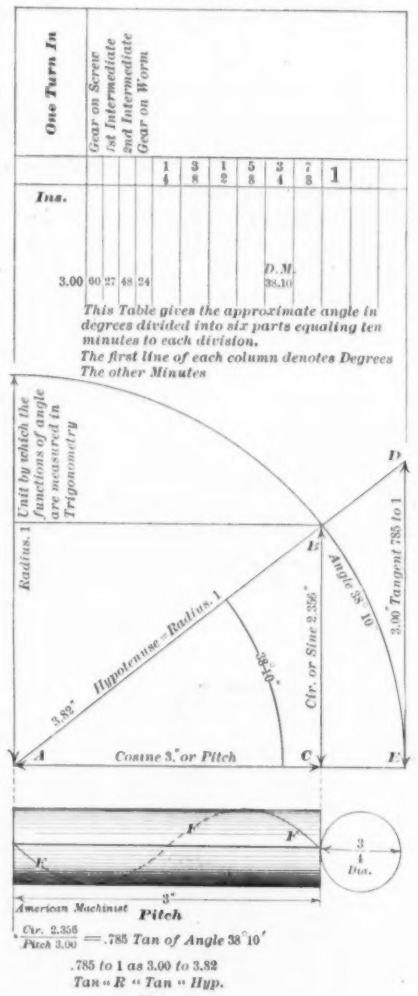


Fig. 2


One Turn In
Gear on Screw
1st Intermediate
2nd Intermediate
Gear on Worm
Ins.
3.00 60 27 48 24
D.M.
38.10
This Table gives the approximate angle in degrees divided into six parts equaling ten minutes to each division.
The first line of each column denotes Degrees
The other Minutes
Radius 1
Unit by which the functions of angle are measured in Trigonometry
Hypotenuse = Radius 1
Cir. or Sine 2.356
Angle 38° 10'
3.00 Tangent 785 to 1
3.82
38°10'
Cosine 3." or Pitch
American Machinist
Pitch
Cir. 2.356 / Pitch 3.00 = .785 Tan of Angle 38°10'
.785 to 1 as 3.00 to 3.82
Tan " R " Tan " Hyp.
Fig. 3

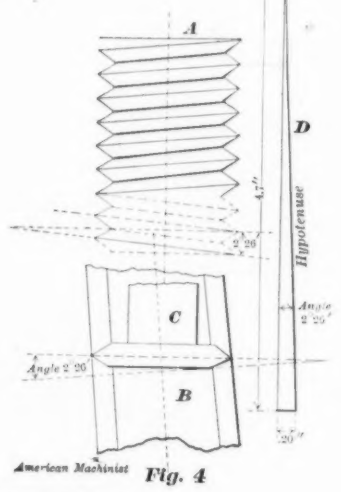


Fig. 4

Spirals on the Milling Machine.

out of the outside guide ring, and placed on an inside guiding ring, and the outside of the rim is grooved, the cutters in the vertical head being changed to suit. This is seemingly a very simple and straightforward method of making wheel rims, and, like all the work done at the "Warwick," the excellence of product is undeniable. The powerful means employed to force the wood strips into close contact while gluing up, and the heavy cast-iron gluing rings used, insure a perfectly joined and formed wheel rim. A large number of gluing rings and inside sectors are required for each size of rim produced, and the operation of laying up the rim is not rapid or cheap. Two men are required in the process, and while the product is as good, probably, as can be had by any method, it demands far more labor and more expensive tools than some other systems of wood-rim making. The method of finishing the rims on the shaper is less objectionable as to comparative cost, perhaps, than any other step in the Warwick wood-rim manufacture.

A large establishment which was opened for full inspection with a request that no mention of name be made, carried out some probably expensive experiments with special automatic wood-rim finishing machines, on the molding machine plan, with rotary cutters, as opposed to the lathe plan in which the work revolves and the cutter or tool is stationary, and said that this plan was feasible, and still in use. None of these molding machines were in use on the day of inspection, however, while a row of special rim-turning lathes was actively employed on the work. The molding machine, the Blanchard lathe, and the gun-stock turning lathe are all milling machines in type, inasmuch as the work is fed to rotary cutters, and in general terms it is safe to say that lathe cuts are cheaper and faster and require less tool making than milling machine cuts; it is true that circumstances alter cases, and statements generally true are sometimes contradicted by special practice, but so far as the bicycle rim finishing is concerned, the lathe seems best fitted for its production.

Hugh Dolnar.

Spirals on the Milling Machine—Notching and Hobbing Worm Wheels.

The common formulæ printed on the tables that accompany milling machines, to be used in connection with twist drill, spiral cutter, worm-wheel cutting, etc., are generally, not only a source of profound mystery to the workman, but to the foreman as well. While they appear simple to the milling machine makers who have prepared them, and are so to anyone familiar with the mathematical principles underlying them, they are a bugbear to the general mechanic, just because he has little acquaintance with such rules, which is, of course, no fault of those who make the tables for use, and not for instruction.

One thing that acts as a barrier to a more intelligent use of the rudiments of arithmetic, which most mechanics possess, is the quite common impression that the use of letters as symbols or signs in mechanical illustration involves a knowledge of algebra in order to use them. This is no more true in connection with geometry or trigonometry than it is with a mechanical drawing where letters are used to designate the parts. Algebra as a mode of calculation, indispensable perhaps in abstruse problems, and preferable as a method in many others, is not by any means identical with letter emblems.

As an illustration, examine the formulæ given by Messrs. Brown & Sharpe in their circular hand-book, where they devote two or more pages to the method of calculating spur-gear dimensions by the rules of diametral pitch.

Having said so much by way of removing a common superstition about lettered formulæ, let us see what one or two of them mean in actual cases of common practice.

For example, if we take one of the index tables accompanying a universal milling machine, E. E. Garvin & Co.'s, for instance, we are confronted with an imposing array of figures, systematically arranged in columns and cross divisions.

To the apprentice boy, or novice in the use of these tables, though he may be an excellent mechanic, this array of figures is something formidable; appearing like the bill of fare to the rustic who thought he must eat everything on the list to get a whack at the pie.

And yet the whole table is only a collection of repetitions, and any line of figures in the schedule is quite simple when analyzed.

Take, to start with, the "Table of Angles and Gearing for Spirals," and right under this title is a series of spaces having inches and subdivisions up to four inches, above which is printed "Inches" and "Diameters." See illustration, Fig. 1. These figures refer to the diameter of the work—twist drill, spiral cutter, or whatever it may be to be cut.

The spirals are the grooves in the drills or cutters to be cut, and the result obtained, though in a different way, is the same as that secured by cutting a thread or screw in a lathe.

If a thread tool, V or square, were held rigidly in the milling machine, in the position of the cutter, standing still, instead of revolving, however, the result would be the same. In this case the action on the work would be like that of a planer pushing the work against the cutter. The same thing occurs in a lathe when using a cutting-off tool. The planer tool is cutting out a groove on flat work, the lathe tool is doing the same on round work. For convenience the work moves instead of the tool in both cases. But the tool might move, as in a shaper or milling machine, when a keyway is planed or milled out. In the planer and shaper the cutter is fed into the work, so in the lathe. In the milling machine the work is fed onto the cutter, for depth of cut, and might be on shaper by lifting the saddle or knee.

But the element of direction is changed in cutting spirals and screw threads, involving a double motion in one or more ways, and the best way to describe it is by dealing first with plane surfaces.

The groove on a screw or spiral cutter, or twist drill, has elements in common with a groove on a flat surface. It is easy to see that a cutting-off tool in a lathe makes the same groove on round work that a planer or shaper tool does on flat work for key-seating, no matter how it is done. Or a groove $\frac{1}{10}''$ deep, made on a round piece 1″ in diameter, would be very nearly the same as a groove 3.14″ long, made with the same tool in any way on flat material, in a planer or shaper; or very nearly the same as any such groove made in a milling machine with revolving cutter or saw, the work or cutter moving in one direction. And in all the instances the cutter of whatever shape is acting upon but one point of the work at a time, so that the provision for clearance on the cutting tool, of whatever shape, must be that required in a cutting tool for straight work, whether used in lathe or planer.

To illustrate in Fig. 2. The cutting tool *a a' a''* must have side clearance as at *a a''* and bottom or end clearance as in *a'* as a general rule. If the groove *b* was to be planed on an angle, as shown at *b''*, then the work or the tool would have to move in the path of that angle either by arranging one or both in such a way that the cut could be made by a movement in one direction, or else, so that the tool or the work, or both in conjunction, could cover the same path by two motions.

In the latter case, the tool *a''* must move diagonally, sideways to *e* and endways to *f*, or the work must move in the same manner towards *e* and *d*, or else while *a''* is moving towards *f* or *e*, the work *b''* must be moving towards *e* or *d*, respectively.

Now, the whole practice of gearing the lathe for screw cutting, and the milling machine for spiral work, as well as setting the table at a proper angle, is the application of this plane movement to curved surfaces.

Coming then to the milling machine table again, and looking at the upper left-hand corner, we find the number of inches to one turn of the work (see Fig. 1). This may be understood by looking at the 3″x¼″ cylinder

at the bottom of Fig. 3. To use an old illustration, take a piece of paper 3 inches long, and its width equal to the circumference of the cylinder, 2.356 inches, with a diagonal *A B* equal to 3.82 inches in length drawn upon it, as shown by the hypothenuse of the triangle *A C B*, and assume this paper to be wound about the ¾-inch cylinder, then will *A B* form the curve *F F F*, *B C* the circumference, and *A C* the pitch.

If we take the hypothenuse and describe a quadrant or quarter of a circle with 3.82″ for its radius, and draw the tangent as shown at *E D*, we have enough trigonometrical elements to explain this particular case.

The tangent *E D* is to the radius *A E* as .785 is to 1, and 2.356 is to 3.00 as .785 is to 1. But 2 356 is the circumference of our ¾″ diameter twist drill or whatever it may be, and 3.00″ is the pitch of the same. So if we divide 2.355 by 3.00, we get .785, the ratio of the tangent to the radius, or 1. The ratios then of circumference to pitch, sine to cosine, and tangent to radius, are in this case as .785 to 1. And by turning to the table of "Natural Trigonometrical Functions," say in Nystrom's Mechanics, p. 247, and finding .785 in tangent column, we find 38° at the top of left-hand column, and 8′ in the column of minutes, to which 38° 10′ is approximate as one-sixth of 60′, as printed on the Garvin milling machine table.

In finding the tangent of the angle for setting the milling machine for cutting a worm wheel the formula is reversed, and reads: $\text{tan.} = \frac{\text{pitch}}{\text{circ. of cutter}}$; or the distance from the top of one thread on the worm or hob to another, divided by the circumference of the same.

In Fig. 4, where the angles are exaggerated to make it plain, let *A* illustrate the worm or hob cutter that is to run in the worm wheel *B*. When the hob is cutting *B* the milling machine is not set on an angle, as that is furnished by the thread of the hob itself; but it is the practice usually to start the work with a cutter like *C*, to be followed by the hob.

In this case the work is placed in position by turning the milling machine table to the angle corresponding with that on the thread of the worm or screw pinion.

In Fig. 4, allowing *A* to be 1½ inches in diameter, the circumference would be 4.71 inches; and the pitch being 5 per inch, the distance from top of one thread to next would be .20″; and the formula would be $\text{tan.} = \frac{\text{pitch}}{\text{cir.}}$, or $\frac{.20}{4.71}$, or $\frac{\text{sine}}{\text{cosine}}$, which would be .0424 for the tangent; and turning to the table of tangents, say Nystrom's Mechanics, p. 211, we find the angle for tan. .0424 to be 2° 26′, or about 2½°.

Looking at *D*, in Fig. 4, it can be seen how the thread on *A* unfolds into such an angle.

In Fig. 3, the pitch made the cosine, and the circumference the sine, while in Fig. 4 the circumference becomes the cosine, and the pitch the sine, which explains the change in the formula.

In Fig. 4 *A*, the dotted lines show the angle on the bottom of the hob which does the cutting, making it plain why the work should be swung around, as in *B*.

The angle of thread is just the reverse underneath from what it appears on top, so that most men in setting the work for cutter *C* to start the same, set the milling machine the wrong way, and can only be convinced of their mistake when they find that the hob cutter will not follow the other.

In starting the hob after using *C*, it should be made to enter the cuts made by the latter, otherwise there is danger of splitting or mangling the threads of the wheel.

Under another head I may describe how accurate graduating machines are constructed by using the worm wheel put together in two or three sections.

I have been prompted to write the above rather prolix description of Figs. 3, 4, etc., from the fact that a number have expressed to me the complaint that too many articles bearing on such topics assume that the readers know more than a great many of them do. While the time and effort seemingly necessary to secure any kind of technical knowledge raises a barrier to their making any kind of an effort in this direction.

A. H. Cleaves.

Chicago, Ill.

A Double Spindle Lathe.

We present herewith two views of a new lathe. This is not, as might be supposed at first glance, an attempt to provide a lathe that will turn two pieces of work at once, but is simply an attempt to satisfactorily solve the problem presented by the man nine-tenths of whose lathe work can be done in a 24-inch lathe but who occasionally has a job of boring or turning which, though perhaps requiring no heavier cuts to be taken than the smaller work does, yet requires more swing in order to handle it at all.

We all know that the usual solution of such a problem is "raising blocks" for head and tail stock. These are much more generally used than machinists brought up in large and fully equipped shops have any idea of, and they are by no means satisfactory. It takes much time to put them in and remove them; they usually make trouble with the feed arrangements, and when the large work is put into a lathe so raised, the rest must be drawn out so far as to render the tool very poorly supported.

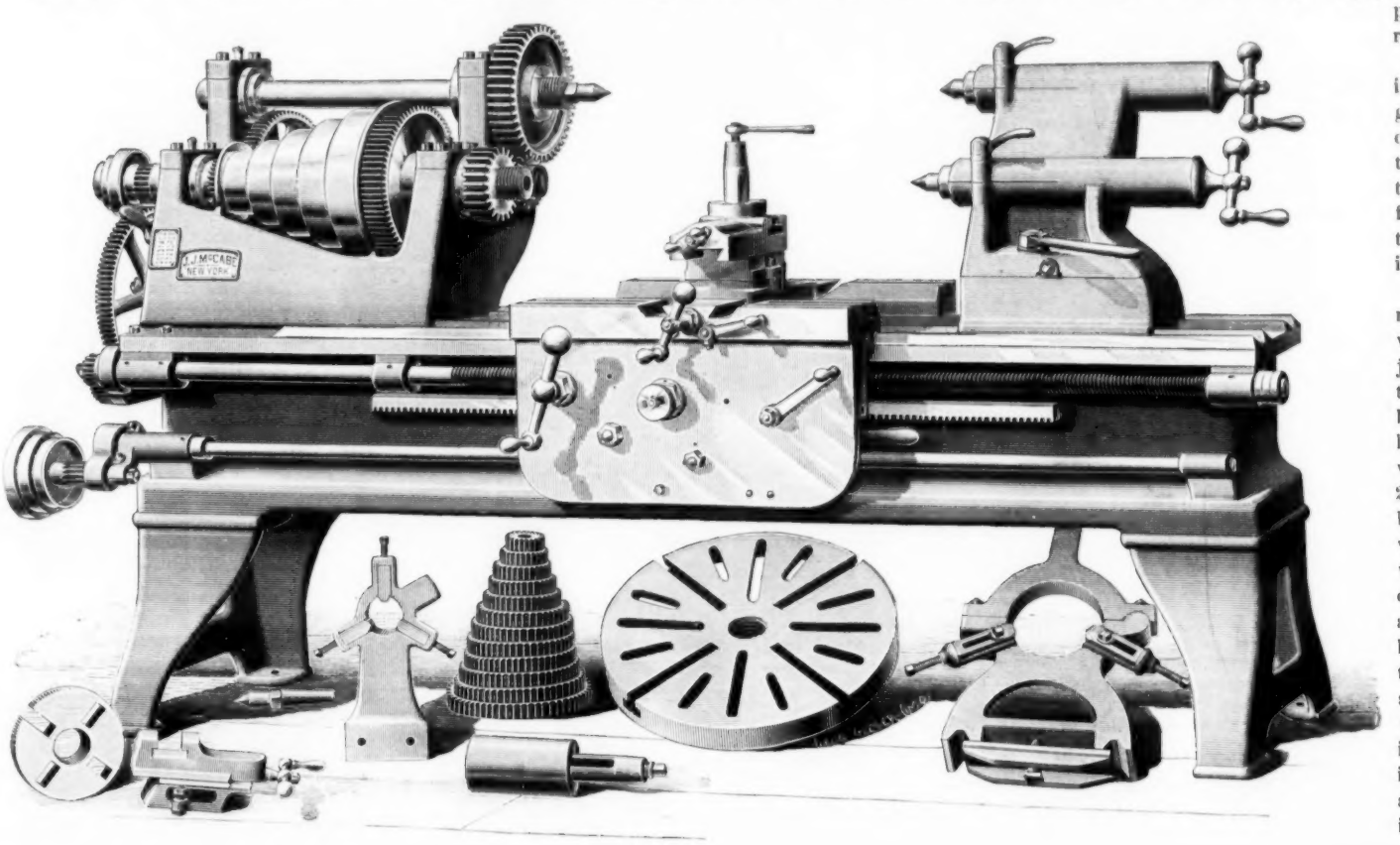
As shown in the front view, the lathe is adapted for use on the smaller work, and is no different from the regular 24-inch lathe of the same make, except that the end of the spindle projects somewhat more to give room for the pinion that drives the supplementary spindle, and the tail stock is somewhat heavier than it otherwise would be. In other respects the lathe is unchanged, and handles just the same as the regular 24-inch lathe; the intermediate being moved out of engagement with the pinion so that the supplementary spindle can remain at rest.

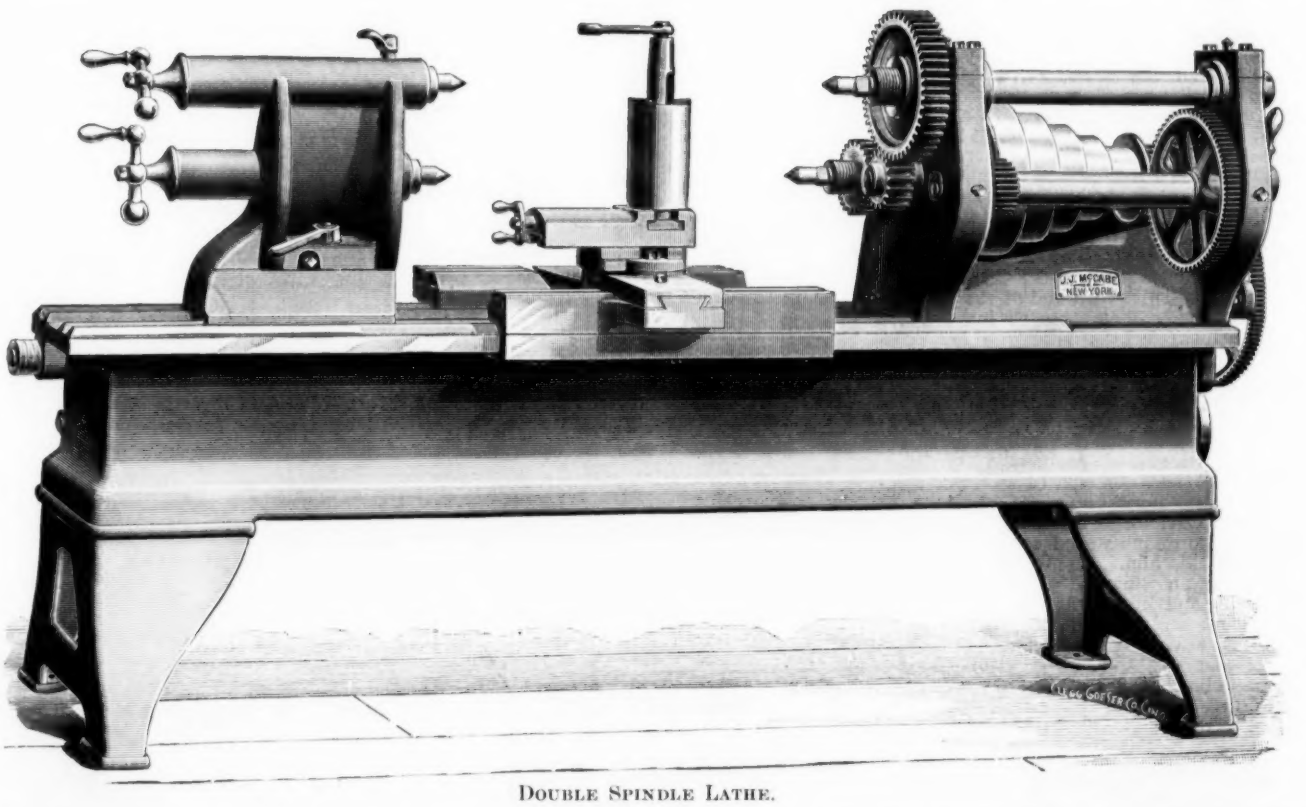
When the larger work comes along, it is only necessary to connect up the gears, put a suitable face plate or chuck on the upper spindle and put the work on the upper pair of centers, an extra tool post being provided for bringing the tool up level with the center if this is desired, though it is, of course, not always necessary.

Though we may wish that every machine shop should be equipped with lathes suitable for doing any job that comes along, it is quite certain that many of them never will be, and it is equally certain that this lathe is much better for the range of work within its capacity than a 24-inch lathe would be with raising blocks, while it is also more convenient and efficient for the smaller work than a 38-inch lathe would be, other things being equal. While it is actually better than the blocked-up lathe it is also always ready, and the time of raising and lowering is saved.

Though the lathe is a rather bold innovation, and will be likely to impress many mechanics unfavorably at first, yet, all things considered, it must, we think, be conceded to have peculiar advantages for the particular field it is intended to occupy. The other features of this lathe will be readily understood from the engravings, though we should add perhaps that the tool posts, though in appearance just like the ordinary ones, are really different and probably more than twice as stiff and three times as good generally as the regular post of that type.

The lathe as shown has a 10-foot bed, takes 6 feet between centers, swings over the carriage 24 inches and 38 inches, has 1 1/16-inch hole through spindle, and weighs 5,500 pounds. It is manufactured by J. J. McCabe, 14 Dey street, New York.





Double Spindle Lathe.

As Others See Us.

In an article by Mr. A. E. Outerbridge, Jr., in the current number of the *Engineering Magazine*, the author claims to have discovered that in this country the labor conflicts which have occurred have been spontaneous uprisings of masses of down-trodden operatives, driven to despair through long-continued oppression. On the other hand, those in the United States have not been of this character, but have been caused and directed by a few ambitious leaders. How truly comforting this creed must be to American employers! Their workmen are always in the wrong, the dupes of ignorant agitators, whilst in England they are equally invariably in the right. We are well aware that the view is pretty generally held in the States that any tumult or riot on this side of the Atlantic is always due to the oppression of a bloated aristocracy, but one hardly expects to find ignorant claptrap of this sort in a journal of the standing of the *Engineering Magazine*, though we have learned to take it as a matter of course in the American daily press. Mr. Outerbridge makes also the usual misstatement as to the absence of class prejudice in the States, a fiction many Americans have repeated so often with a view to tickling the ears of the groundlings that they have at last come to believe it themselves, though almost every village there has its exclusive clique, and in certain parts of the States a white American citizen refuses to ride in the same car with a colored one, a somewhat curious commentary on the social equality boasted of by Mr. Outerbridge.—*Engineering* (London).

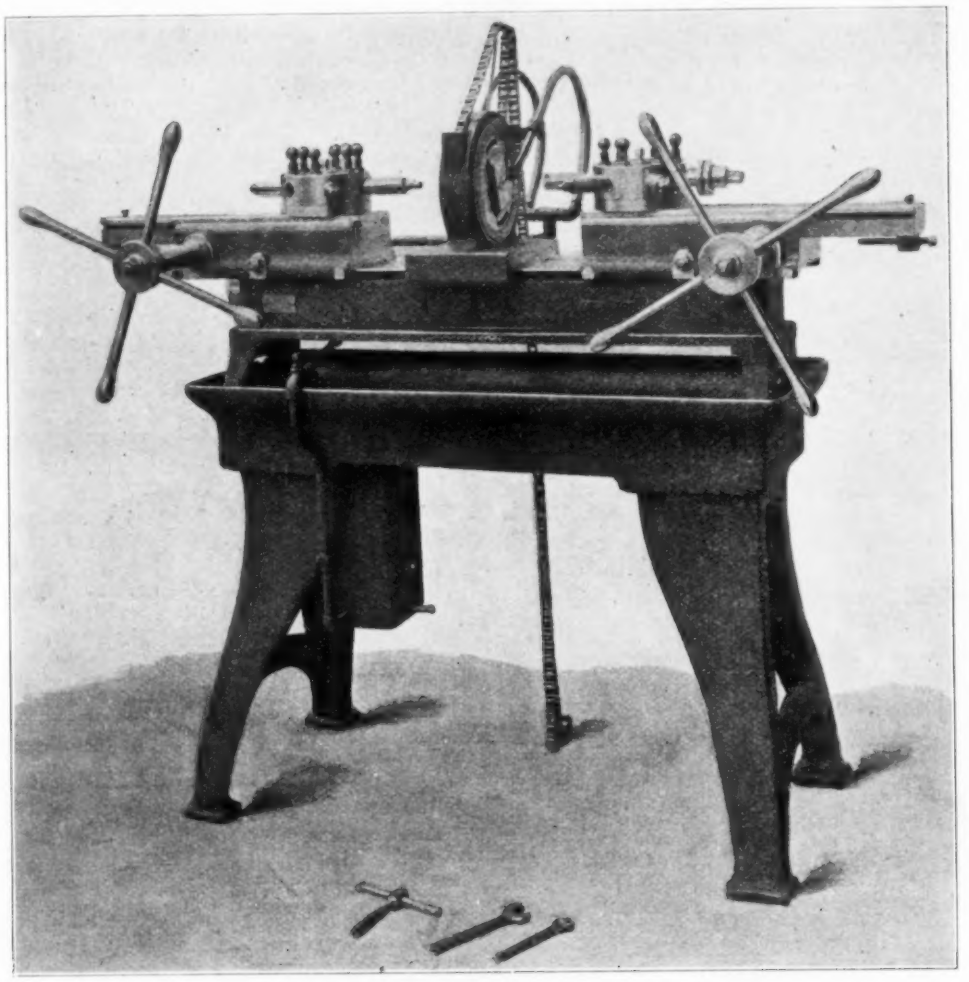
Management of Men—Nursing Jobs.

Clarence E. Bement, of Lansing, Mich., read a paper before a recent meeting of the Michigan Engineering Society, in which he said:

No problem worries the average superintendent more than the management of the men. As a plant increases in size and more men are employed one loses his personal grip on the employes, and is more frequently tempted to deal with them as a body, and not take personal peculiarities and conditions into account. This on the part of the employer leads to lack of sympathy, and the laying down of arbitrary rules that do not always work to the advantage of the men, and on the part of the men to a spirit of "not caring a damn" that is most injurious to the employer. A spirit of accommodation must be cultivated, and no superintendent should ever decide a question with relation to his men while angry. In my judgment more labor troubles arise from both sides going off at half cock than from any other cause. Small personal accommodations to men I have found of the greatest value in tying them to one's interest and making them feel that your good and prosperity was theirs. But in this connection the foreman becomes of great importance, as well in that as in the direct manufacturing. A superintendent's grief in connection with the handling of men generally comes from those departments whose foremen lack judgment and good common sense. But foremen are the most important elements in good and economical manufacturing. It is very easy to define a good foreman, but not so easy to find him. He must, to crown all, be systematic, then be able to get along with men, and know when they are doing a day's work and how to make them do it. He must have firmness, determination and nerve, and ought to be a first-class mechanic in his line.

In these days of piecework there has arisen a new difficulty in manufacturing. It is called nursing a job, and consists in doing only as much of a day's work as will make fair wages and not lead to a cut, the man arguing that if he makes $2.50 per diem on his machine his piece price will not be disturbed, while if he makes $3.50 per diem, which he can easily do, it will simply result in his wages being cut to a basis of $2.50, and making him work so much harder. This system of nursing jobs exists in every shop where piecework is being done, and especially where a number of machines are doing the same class of work, and you are largely dependent upon the sagacity of the foreman to discover and remedy the trouble. It sometimes necessitates the changing of the entire force. Another drawback to piecework is the education of the men to think that it is worth more to do the same thing by the piece than by the day. For example, a man might turn out a hundred pieces of a certain kind for a day's work, for which he would be satisfied if he received $1.50 per day, but if you wanted him to work by the piece he would expect to receive $2 for the same amount of labor. In other words, the men look upon piecework as a sort of fetich which the employer is willing to pay something for worshiping.

The men who expect to receive more per piece for doing work by contract than they receive for the same work done by the day cannot be numerous in the machine trades, since, so far, they have entirely escaped our observation.



Double Screw Machine.

Special Double Turret Screw Machine.

We give an illustration of a screw machine adapted especially to bicycle work, such as the H pieces for pedals or other parts that require to be machined at each end, and where it is an advantage to do both ends simultaneously.

Such a piece is held in a special pair of jaws in the chuck, which is mounted in a special rest placed midway of the bed. The chuck revolves in a ball bearing, and is driven positively, regardless of oil, by the chain shown, which, when the machine is working, passes over a sprocket wheel on the countershaft.

There are three friction-clutch pulleys on the countershaft, providing for necessary changes of speed and also a backing motion.

Both turrets revolve automatically and have six holes for tools.

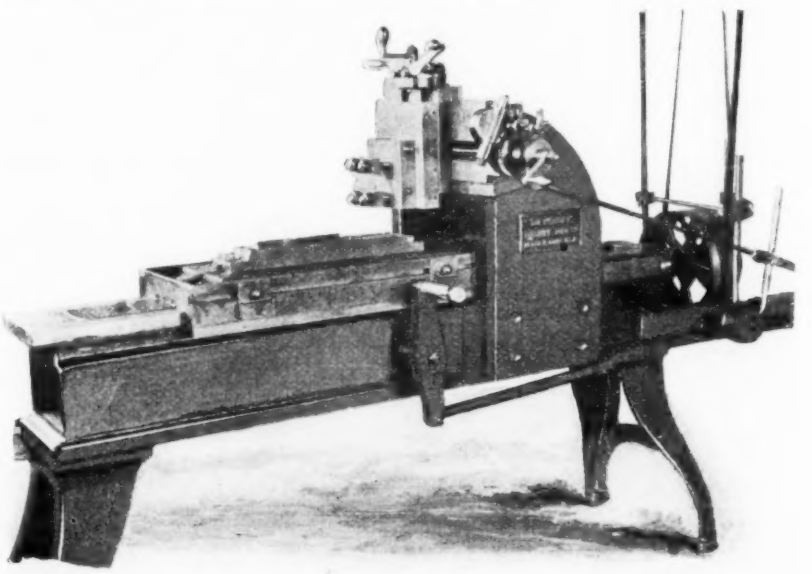
The bed, chip pan, etc., are the same as the regular No. 2 screw machine of the same make, and the machine is made by The Garvin Machine Co., Laight and Canal streets, New York.

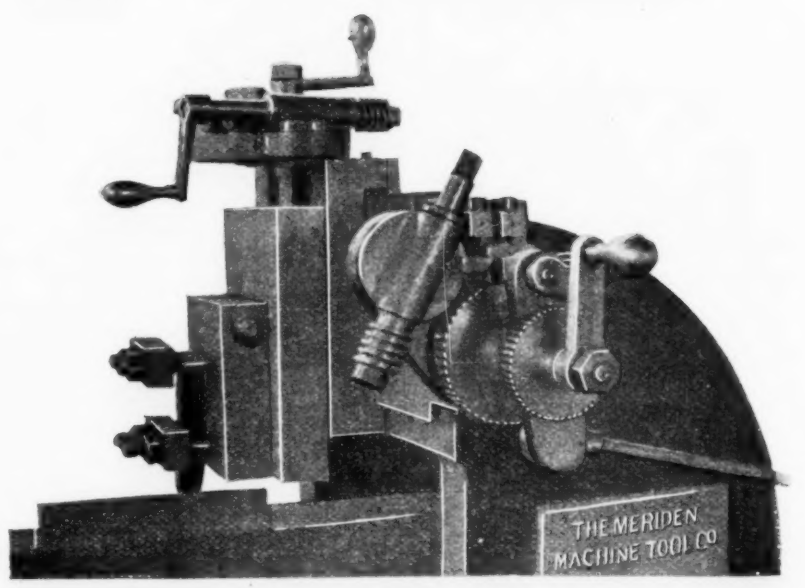
A Special Planing Machine.

Mr. W. L. Cheney, of the Meriden Machine Tool Co., Meriden, Conn., having found some difficulty in getting forming tools planed up in the way he thought they should be done, finally built a machine for the purpose, which machine forms the subject of this article.

As we believe in labor-saving devices (devices which save us labor), we asked Mr. Cheney to himself write out an account of the machine, which he does as follows, with a few modifications:

The idea of the planer is this: We could not finish the surface of forming tools smooth enough on anything less than our 20-inch planer. Having worked in a shop yourself, it will be unnecessary to enlarge on the "innate cussedness of inanimate objects" that always made it so happen that when we received a particularly urgent order for a forming tool, this 20-inch planer had just begun a lathe bed that couldn't by any possibility come off that planer under two days, and that when we did finally get started on forming tools, there would be such an accumulation of them that we couldn't plane another lathe bed for a week, in consequence of which we had to get many lathe beds planed outside, and then after the rush was over, have the satisfaction of seeing the big planer without work for a while. From an æsthetic point of view it was also annoying to see a big planer tied up planing a little piece of steel not over an inch big. Well, then (Benj. F. Wilson, forgive me), the problem was to find something that *would do* this work, but that wasn't big enough, so we would be under the temptation to put lathe beds on it—see? Said "crank planer" couldn't find any crank planer that would plane over about 15 inches long, while we must be able to plane 24 inches at least. Came to the conclusion that we could fake up something for the same or less cost than the crank planer that would do us O. K. Thought might as well make it plane 36 inches while about it, as it wouldn't cost any more, seeing we had a 6-foot lathe bed pattern. Took this pattern, thickened it all over, so it's not less than 1 inch thick anywhere, tacked on pieces for cheeks, etc. The housing is not less than 2 inches thick anywhere, is in one piece, is bolted to sides of bed, and keyed beside. The opening in the housing is 14 inches wide, and 5½ inches high above the table. There is no movable cross rail, all necessary up-and-down motion for a 5½-inch opening





Special Planing Machine.

being evidently capable of achievement (good word) with the slide that holds the tool box. This, of course, adds to the rigidity.

The table is gibbed to the bed. The table has a babbitted nut 6 inches long; the screw is 2 inches diameter, ½ inch pitch, and is the good old reliable square thread. The ratio of belt speed to table speed is 75 : 1, in consequence of which this planer will take a chip that would keel the 20-inch planer right over. The amount of cast-iron in it lets it take a very smooth cut on finishing forming tools, which we do with thin pieces of steel filed to the shape wanted, and held in a special holder.

The thrust of the screw is taken by ball bearings; the worm feed is to overcome the difficulty we had in taking broad cuts in finishing on the regular planer formerly used; the operator would tap the handle of the feed screw with a light copper hammer, which was all right when he wasn't thinking of his girl, or something of the sort. Otherwise (and usually), he would hit it a little too hard just about two chips before the last, and either break the cutter or tear the whole thing up so it was necessary to begin all over again—usually both.

He now feeds the worm shaft about a quarter of a turn, and gets the same result that he formerly got with the copper hammer when he had good luck. When used for rough work or for ordinary planing the worm gear is thrown out. The picture shows that the worm shaft is in a swivel box, and a latch holds it in gear or out of gear respectively, by bringing up against one side or the other of a pin. The position of the latch is adjustable by two screws for wear. When the worm is out of gear the screw is worked by the handle in the usual way. The worm arrangement is exactly the same on both screws. The power cross feed is taken from the stud on the same rocker that carries the belt shipping fingers, and the amount of feed is easily varied by moving the clamp that carries the rod nearer to or farther from the center. The construction of the shipping cam is shown in the sketch. The cam itself is simply a piece of 4 inches wide by ½ inch thick machinery steel, with the slot cut as shown. A roll on the same stud that carries the rocker (the rocker that carries the belt-shifting arms) supports one end of this cam, and the connecting rod, which is pivoted to the reversing lever worked by the table dogs, supports the other end of the cam, and the cam is held in place laterally by the belt-shifting rocker itself, and has no other guide than these. Of course it does not move strictly in a straight line, as the variation due to the arc in which the reversing lever moves (being pivoted at its center) affects the cam slightly, but it shifts the belt all the same, and is practically O. K., and is as cheap and efficient a device as I have seen. There is no power down feed, as it is evidently not needed for our special work.

Improved Milling Machines.

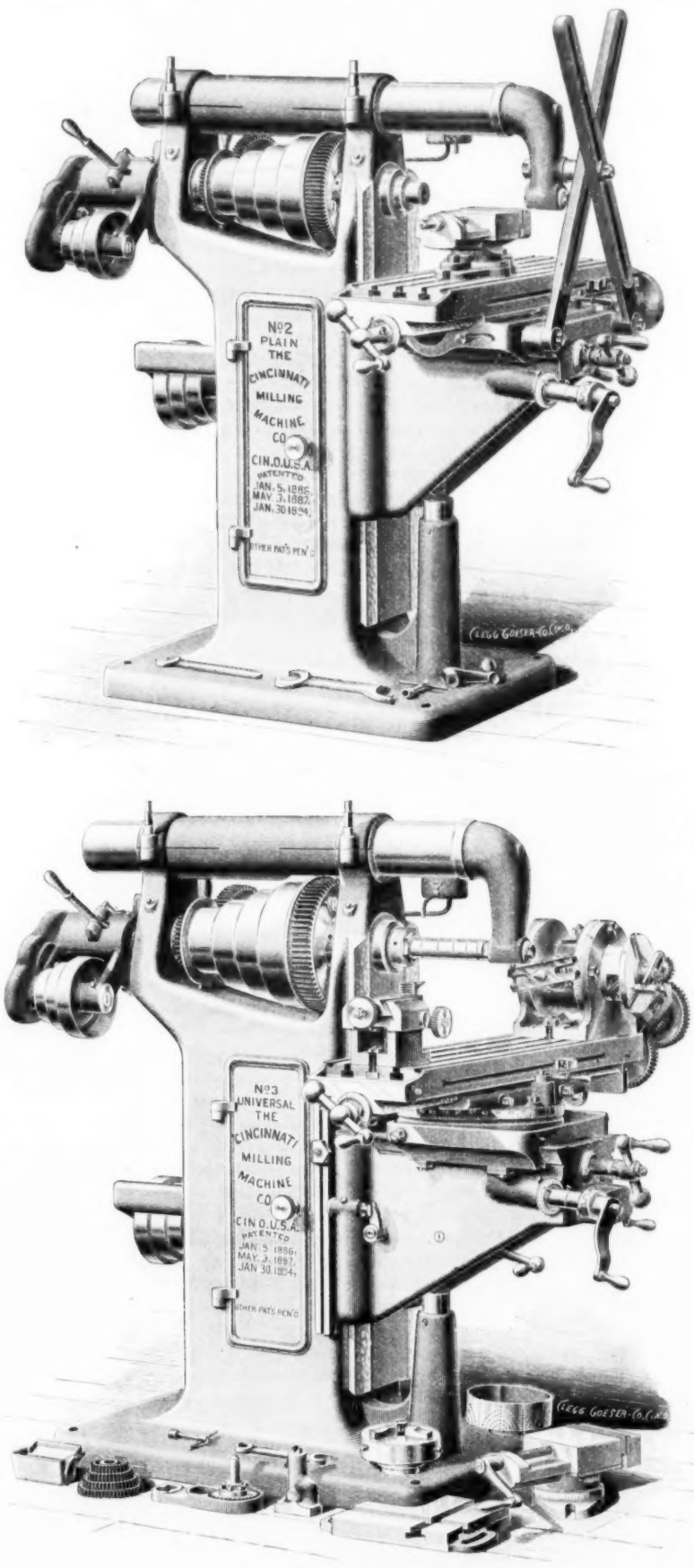
We present herewith illustrations of a plain and of a universal milling machine that have some new features.

Referring first to the plain machine and omitting mention of those features clearly shown by and understandable from the engraving, we note that the main spindle is hollow; has a tapered front bearing running in a solid, babbitt-lined cast-iron box. Provision is made for adjustment for wear. Large cone pulleys and a wide belt are used, and as there are two speeds to the countershaft, the back-geared machines have 16 spindle speeds, which are in regular progression.

At the rear end of the spindle is a new feed-driving device, by which three different rates of feed are obtained by simply moving the small lever shown. Taking the middle position of the lever, moving it in one direction doubles the speed, and moving it in the other halves it, a pointer upon the lever indicating the rate at which the machine is feeding. Then there are four steps upon the feed cones, and thus a total of 12 different rates of feed.

The importance of the wide range of feeds and the lever changes will be appreciated by experienced milling machine men. The feed is also made powerful; the feed belt being 1½ inches wide, and running on large feed pulleys.

The arrangement of the crank handles by which the machine is manipulated is the same as has been previously used by the same builders, the shaft by which connection is made to the elevating screw being placed at such an angle that the crank can remain upon it, ready for use at all times



New Milling Machine.

without interfering with the cross-feed crank. In the larger machines a special anti-friction bearing is used to facilitate raising the knee. All movements are indexed by plain dials, reading to .001 inch, and the platen is locked in position when desired by the small lever seen at the left of the knee. The feed is in either direction, and is automatically thrown out by dogs which are so arranged that the platen can be moved by hand past either of them without changing their position. The feed is reversed by the small lever seen on top of the saddle, and the platen has a quick return.

Three sizes of this machine are built; the one we illustrate being the medium or No. 2 machine, which has a platen feed of 24 inches; cross motion of saddle 7½ inches; vertical movement 20 inches; working surface of table 34x10 inches; range of feed from .006 inch to .187 inch per revolution of spindle; distance from center of spindle to overhanging arm 5 9/16 inches, and weight 2,000 pounds.

The same description applies to the main features of the universal machine, which has its platen mounted so as to swivel to any desired angle; the swivel base being circular and of the largest possible diameter, so that at whatever angle the platen may be set the bearing is the same, and is a large one. Four bolts, easily accessible, bind the swivel plate in any desired position. Graduations are placed on the outer edge of the swivel, and the platen may be turned completely around and spirals cut up to and beyond 45 degrees if desired.

This machine is also regularly fitted with an automatic feed for the saddle (in line with the spindle) and with automatic, vertical feed for the knee also if desired. All feeds are controlled by levers conveniently located and operated from the front of the machine.

The indexing head is so arranged that the swiveling block carrying the spindle can be turned clear over, a complete revolution, so that it can be used in either direction. This gives the operator more choice as to the character of cut he shall make, and in cutting bevel gears, for instance, permits some cuts to be taken without tendency to lift up, or dig into the work; which might otherwise be troublesome on this account. By this arrangement also right and left-hand cuts can be taken without changing the cutter. The block carrying the spindle is always fully contained within its support, and there is a device for locking the spindle while a cut is being taken, thus relieving the mechanism from strain. There is on this spindle a cup-shaped dial for rapid indexing.

The tail stock has an adjustable center bar which is raised and lowered by a rack and pinion for taper work, and there are two centers formed upon the bar—one for the smallest work, the other for larger work. Indexing can be done up to 360, and there is a full set of change gears for cutting spirals.

Two sizes of this machine are built, the larger or No. 3 size, which we illustrate, having a length of platen feed of 27 inches; cross motion in line with spindle 7½ inches; vertical range 19 inches; working surface of platen 43x9½ inches; swing on index centers 21x12 inches; range of feed per revolution of spindle .006 inch to .15 inch. Its net weight is 2,800 pounds.

A good idea of the methods pursued in the manufacture of these machines may be had from the articles published in our issues of August 29th and September 5th, in which some of the special devices employed by the builders, The Cincinnati Milling Machine Co., Cincinnati, Ohio, are described and illustrated.

LETTERS FROM PRACTICAL MEN.

Radial Icicles.

Editor American Machinist:

It seems quite possible that if your correspondents continue the discussion of the above question, they will explode the old notion that particles leaving the periphery of a revolving wheel by centrifugal force go off on a tangent. So far as the wheel itself is concerned, the icicle, whether solid or liquid, never has, nor never will do anything of the sort. The drop of water starts off in a radial line, and were it not for atmospheric resistance and gravity, I fancy it would go on an involute curve, starting radially. Should a sheet of paper be fastened to the side of the bicycle wheel, and a frictionless pencil be caused to draw a line on the paper as it leaves the rim by centrifugal force, the result would be very unlike a straight line tangent to the wheel.

If your correspondent who disputes the radial fling of the mud, because the bicycle rider gets splashed in the back, had thought twice, he might have abandoned the argument. Although the rider is going forward as well as the wheel, he is only going half as fast as the top of the wheel, and so has just as good chance to get too much mud, as if neither wheel nor rider were advancing.

John E. Sweet.

A Stump Lathe.

Editor American Machinist:

I once worked at Smith & Black's, they ran a country job shop, and did anything that came along, from sewing machines to saw-mill work.

One day a man brought in a job; it was a square 4-inch shaft about 12 feet long with an 8-foot lagged pulley on one end; he said the pulley was on so "all-fired hard" he couldn't get it off, said it got loose about a year ago, and he took some "salmony" (sal ammoniac) and made a rust joint, and it had stayed ever since; well, he wanted a bearing turned about 2 feet from the end of

the shaft, to steady it in running; as our "long" lathe was but 20-inch swing, and would take but 8 feet between the centers, I did not see how it could be done.

The old man, he went out and looked the job over, and chewed a stick awhile, and finally told him to unload it.

The shop set near an old apple orchard, and one of the trees grew so near the shop, you could pick the apples from the pattern shop window—although I never tried it (?).

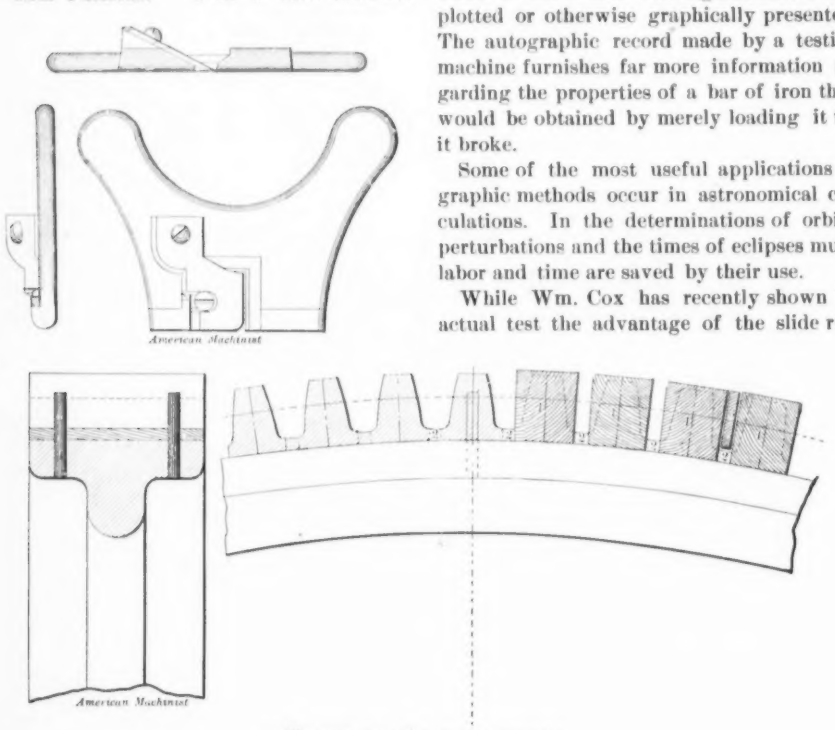
The next morning the old man took the patternmaker and myself, and struck a line level with the shears of the lathe out of the end window and across the trunk of the apple tree, then he had us saw the tree off so the stump was level with the ways of the lathe, the tail stock was then carefully set on the stump and secured with lag bolts, the shaft and pulley put in, and the end held by being clamped to the face plate (we didn't have any chuck), the center of the shaft was held in the steady rest, and the bearing was turned as ordered.

It was a good job well done, but I never knew if the stump was inventoried as tools or real estate. A. P. Press.

Teeth on Gear Patterns.

Editor American Machinist:

I was glad to see Mr. Dingey's article in the American Machinist of August 22d, on "Gear Patterns." I do a little different



Teeth on Gear Patterns.

from Mr. Dingey; I make spur gear patterns by turning the blank under size, but I glue all the teeth on and pin them from under side on large patterns and from points of teeth on pinions. I space carefully for blanks, and glue on the small pieces for bottoms of space first, having them just the right width and hight; then glue on the blanks for teeth, and last fill the space between tooth blanks temporary to keep from breaking off the ends when turning to size. In the sketch I send 1, 1, 1 are the tooth blanks, 2, 2 bottom of space, 3 temporary piece, and 4 is pins; this method insures a good strong pattern and leaves the fillets with no feather edge to break off.

I think the dovetailing method out of date and not as good as to have the teeth put on solid. I find but little difference in working teeth on the wheel or off, the time saved from not dovetailing will more than make up for the extra time it takes to work the teeth on the wheel.

I send herewith a sketch of a small plane I had made to assist in working out teeth of gear wheels when fastened on to the pattern, it is made thin enough to go between the teeth, and is a great help after a very little practice. Ezra Estep.

Plano, Ill.

Graphical Methods and Logarithms.

Editor American Machinist:

The graphical method of finding the powers and roots of numbers given by "M. E.," in your issue for August 8th, certainly possesses the merit of combining in a single diagram the methods of finding any root or power of a number very readily after its square and square root are found.

The practical difficulty with many graphic methods was pointed out in the American Machinist for May 23d. Where lines intersect at an acute angle it is difficult to determine the exact point of intersection or to measure the lines accurately.

I agree with "M. E." that the *reasonable* uses of graphic methods and diagrams will admit of much further development. Perhaps the chief advantage of the graphic diagram lies in the ability by its use to form a *continuous* graphical record from a series of isolated facts or numbers. In other words, if the value of one quantity, be it the horse-power of a steam engine, or the population of a city, or anything else, is dependent on some other quantity, as the steam pressure or time, we can, by plotting a few values of one quantity, corresponding to known values of the other, obtain a graphical record of all the values of and changes in the quantities. And, as in the case of statistics, we may often extend the graphic record with some degree of certainty *beyond* the limits of the known values. Tabular numbers or statistical facts are "stubborn" in more ways than one; they can hardly be made to show their full significance unless plotted or otherwise graphically presented The autographic record made by a testing machine furnishes far more information regarding the properties of a bar of iron than would be obtained by merely loading it till it broke.

Some of the most useful applications of graphic methods occur in astronomical calculations. In the determinations of orbits, perturbations and the times of eclipses much labor and time are saved by their use.

While Wm. Cox has recently shown by actual test the advantage of the slide rule over other so-called rapid methods of calculating, each mechanic will doubtless continue to solve mechanical problems in his own chosen way, confident that it is the best because it serves him well. Perhaps I may be permitted to say a word in favor of old-fashioned logarithms for performing engineering calculations. I refer not to the common five-place tables, but to the more extensive seven-place tables (such as Vega's), giving the logarithms of all numbers from 1 to 100,000. This is the class of table usually used by astronomers where the utmost exactness is required, and I have found them the most convenient for mechanical calculations, even where no great accuracy is required. For, aside from being able to find the logarithms of larger numbers, or numbers corresponding to given logs. to a greater number of decimal places without interpolating, one may generally avoid interpolating, since if a number is to be found from its logarithm we have ten times as many logarithms, and hence so many more chances of finding a logarithm exactly corresponding to that given. With such a table as great accuracy may almost always be obtained without interpolating as could be obtained with a slide rule with the additional advantage that where greater accuracy is required little additional work is necessary, since interpolations may be made mentally very quickly with the tables of proportional parts on each page.

With a little practice one may learn to multiply or divide a logarithm by two, or subtract it from one without taking it from the table. So that to find the square, square root or reciprocal of a number it is only necessary at most to write down the logarithm of the result. Even this is unnecessary in finding reciprocals, since by beginning at the left and subtracting each figure from nine, except the right-hand figure, which should be subtracted from ten, we may perform the subtraction and carry in mind the remainder or logarithm of the reciprocal, so that on turning to the place in the table where this is found we may read off the reciprocal without having written down a single figure. Logarithms may be more easily carried in the mind by reading them in groups the same as they are arranged in the table. Thus the logarithm of 99.347 is written 1.997 1548 and is read mentally "one, nine ninety-seven, fifteen forty-eight." Where a series of numbers are to be multiplied or divided by a common factor its logarithm may be written once for all on a card. By placing this above the logarithm of the number in the table the logarithm of each product may be read off directly, forming thus a sort of makeshift slide rule. Other ways of facilitating the use of logarithms in mechanical computations might be mentioned, but enough have been given to show that there are logarithms and logarithms, and like the slide rule or monkey wrench, or any other tool used by the mechanic, they must be properly handled if the best results are expected. The writer learned the use of logarithms when a boy of sixteen, and I venture to state that I have not worked out the square or cube root of a large number by the tedious arithmetical method a dozen times since.

I take this occasion to correct an error which appeared in Fig. 2 of my article on "Graphical Methods," published May 16th. The line *B D* designated "*N*" should have been N^2.

R. E. Horton.

Albion, Mich.

A Convenient Brass Furnace Cover.

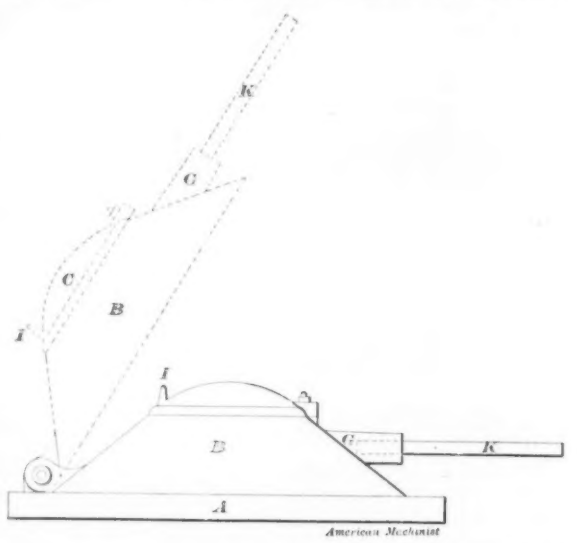
Editor American Machinist:

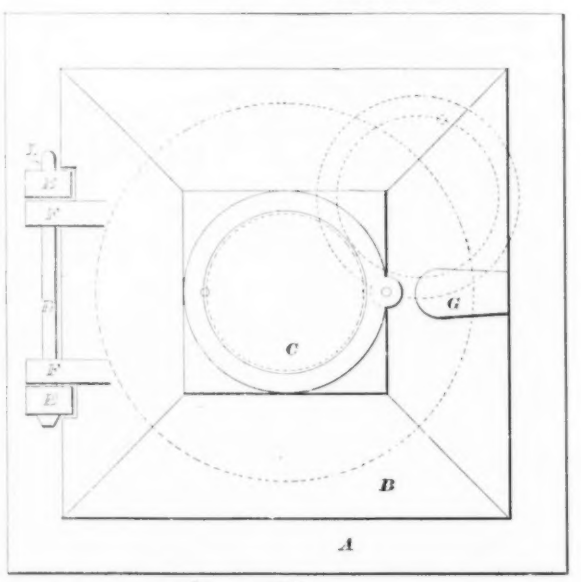
I have received a number of useful hints from correspondents in your columns, and believe it only fair that those who receive instructions in that way should *try* at least to reciprocate. The sketch shows a brass furnace top cover and movable lid that I adopted some time ago.

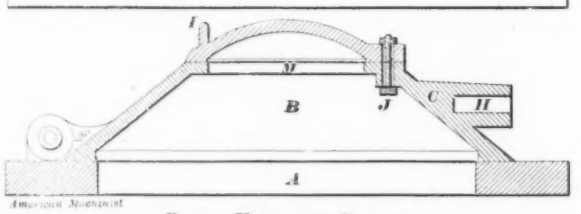
In a large number of foundries doing brass melting some antiquated methods are in vogue; especially is this so in the number and variety of furnace covers, not one of which is adapted to the use to which it is put, and I know of no reason why such landmarks should be retained, unless it be because of that unwritten law, "anything is good enough for the foundry."

In very many cases a common square plate with a hole in the center, cast in open sand, is used, which will inevitably crack in two the first time it is used. Others use a cast plate with a flange all around, in order that it may hold a lining of fire brick, which must be very heavy and unwieldy, and cause a great deal of trouble to keep in repair.

The cover here shown I have been using for a number of years, and have had the same cover on one furnace melting two to three pots per day for over one year without renewing.







Brass Furnace Cover.

The furnace may be built round or square. *A*, Fig. 1, is the top ring or plate, and should be made 1¼ inches to 2 inches thick, and must have two lugs, *E E*, cast on as hinges for *B*; also a hole in the center the size of the furnace inside.

B, Figs. 1 and 2, represents the cover made conical to allow for air space over the pot, and prevent its *warping or cracking*. It is necessary to have two lugs, *F F*, for hinges; also a lug *G* to lift the cover *B* up with.

C, Figs. 1 and 2, is the lid that covers the hole *M* in the center of *B*, and is removable right or left to allow free access to the pot. It is held in place by the bolt *J*, which should be opposite the hinges *E*, *F*, so that when raising the cover *B* it will remain in place.

When ready to take out the pot, the bar *K* is inserted into the lug *G*, and the cover *B* is raised and laid back, as shown in dotted lines. *H*, Fig. 2, shows the opening in the lug *G* for the bar *K*.

I is a lug cast on the lid *C* so that it may be moved around as shown by the dotted lines in the plan. The hinge bolt *D* has a head on one end, and is put through the lugs *E F*, and held in position by a pin through the end at *L*. The design will give a very neat appearance to the furnace, besides being essential for good results. It is not necessary to make the pattern for the cover over ⅛ inch in thickness all around.

Jerome Weyhenmeyer,

Foreman of Jeanesville Iron Works Foundry.

Jeanesville, Pa.

Courses of Study in Marine Engineering and Naval Architecture—The Fastest Vessel.

Editor American Machinist:

I would like to call your attention to one or two statements made in the American

Machinist of September 12, 1895. First, in answer to 338, part 2, I would like to state that the Mass. Institute of Technology offers courses of study in marine engineering and naval architecture as well as Cornell University. Second, on page 731 of same issue you state that the fastest war vessel afloat is the French torpedo boat "Forban." In the issue of August 30, 1895, of *Engineering* (London), on page 277, under the head of 'Notes," they give a brief description of the Russian torpedo boat destroyer "Sokol," which although built under a guaranteed speed of 29 knots made a maximum speed of 32 knots and a mean speed of 30¼ knots per hour, or a mean speed .05 greater than the "Forban" and a maximum speed 1.8 knots greater. It might also be interesting to note in your columns the high-speed river launch built by J. I. Thornycroft & Co., and whose boiler is described in the same issue. The remarkable part *is* the boiler which develops steam to supply a 60 horse-power single cylinder engine, and weighs complete only 12 cwt., or about 22 pounds per horse-power; also the use of water-tube fire bars.

R. A. M.

Why Monkey Wrench?

Editor American Machinist:

Can anyone tell us why the adjustable wrench is called a *monkey wrench*. I know that lots of *alleged* workmen monkey with it, using it for a hammer, using it backwards to the discomfort of their knuckles, then throw it bang across the shop, etc, but why call this universally useful tool a *monkey?*

When I worked at H. P. Moses' shop at Polk Street Bridge, Chicago, in 1856, as an apprentice, Mr. Moses informed me that it was not named monkey at all, that the name was *Munger*, after the first inventor, and so I was taught in that shop to call it. I do not know that such was the fact, but I have always believed it.

If Munger was the inventor of this excellent tool, why call him a monkey? It doesn't seem fair. Geo. B. Foote.

Helena, Mont.

[In our issue of May 28, 1891, we published something on the origin of the name monkey wrench, and a letter from a large monkey wrench manufacturer on the subject. Mr. Foote's letter gives a new theory, or at least a new name to its inventor, but the origin of the term will probably turn out to be "one of those things that no fellow can find out." The wrench will continue to be used, however.—Ed.]

Heating a Shop by Steam.

Editor American Machinist:

In the issue of September 5th, Mr. Hyde asks for suggestions as to the best way to heat a two-story machine and woodworking shop, and I would offer the following for consideration: As the engine is located at one end of the building, the exhaust pipe may be run up at the center of this end and out at the roof, with a back-pressure valve of the noiseless type above the outlets on the upper floor, and the outlet on each floor should be one-half the area of the exhaust pipe. From these pipes two other pipes should branch off by means of suitable tees to both sides of the shop, the outlets to these branches being each one-half the area of the outlet from the main exhaust pipe in order to prevent a too rapid contraction of the pipe areas, and this should be avoided throughout the system.

The wall system puts the heat where it is needed most, namely, at the outer part of the room and near the floor, and if these parts are protected from the cold the remainder of the room will always be warm. In this case the pipes are not in the way of pulleys, shafting, and the cranes used in handling the material. The pipes on the side of a room should be in at least two coils or banks, in order that a part of the steam may be shut off in mild weather. One of these should be about twice as large as the other, as this arrangement admits of adapting the amount of heat used to the state of the weather, resulting in the saving of steam and more comfortable rooms. All of the coils should be connected to one pipe at the other end of the building, and this pipe should discharge into a receiver containing a float which will open the throttle valve of a steam pump (when the water rises in the receiver), and the hot water will be returned to the boiler without being released from pressure. Sometimes an open tank is used for this purpose, but it causes a great waste of heat.

The exhaust pipe should be provided with drips properly located to carry off all of the water of condensation caused by heating the feed water, so that none of it will be raised into the heating system.

It is very important that a good grease extractor or separator should be located near the engine cylinder, in order that none of the cylinder oil may find its way into the boilers. There should also be a valve in the exhaust pipe connecting with the boiler, the valve may be a gate valve, but an angle valve put on in place of an ell, or a cross valve put on in place of a tee, is better, so that the heating system may be used when the engine is not running. A pipe of suitable size should convey steam from the boiler to this valve, and in this line of pipe there should be a reducing valve set so as to reduce the boiler pressure to about two pounds in the system.

The operation of this arrangement is as follows: When the fireman has raised steam in the morning, he admits it to the reducing valve, through which it passes to the heating pipes and warms the shop. When the engineer starts the engine and the exhaust steam is discharged into the system, the reducing valve is either partially or wholly closed, and for the remainder of the day no more live steam is used than is needed to keep the pipes full.

The exhaust pipes of both the boiler feed and receiver pumps should be connected to the system, but they should enter in front of the grease extractor or separator, that the cylinder oil coming from them also may be removed.

This may seem to be an elaborate plan for a small shop, but in this case the receiver and separator will be small and inexpensive. If the heating pipes are all above the boiler and it is desired to use live steam exclusively, the water of condensation may be returned to the boiler by gravity, but the return pipe should be large enough to prevent the collection of a body of cold water in it. If some of the coils are below the water level and live steam at boiler pressure is used, an Albany trap or some similar device should be used to return the hot water. Provision should always be made for blowing the first water that returns when steam is turned on into the sewer, that no cold water may go to the boilers, in case no trap is used, and to prevent hammering in the pipes when there is one in use.

It is a great mistake to discharge all of the exhaust steam from an engine into the air, and then use live steam for heating, etc., for the exhaust may be used without any expense after the system is properly piped. It is not a question of "does it pay to use exhaust steam?" but of whether it pays to properly arrange the piping, valves, etc., or not. W. H. Wakeman.

Why the Pressure in a Steam Boiler Remains Nearly Constant During Blow-Off.

Editor American Machinist:

In a recent number of the American Machinist this question is raised by a correspondent, and as this seemingly strange behavior must have been wondered at by many others, an explanation seems in order.

Water ordinarily boils at 212° F., but when under a greater than atmospheric pressure, as in a steam boiler, the boiling point becomes higher, varying for each pressure. At 80 pounds gage it does not boil until the temperature is 324° F., and at 79 pounds the temperature is nearly a degree less. If then a cubic foot or any given quantity of water be reduced in pressure from 80 pounds to 79 pounds gage the degree of heat that must pass from it will evaporate a portion of it into steam. This is what happens at each sudden increase of load on an engine, otherwise our steam gages would show a merry dance. It is most noticeable in the running of the engine after the fires have been drawn. The steam space of the boiler is only equal to a supply of steam for a few revolutions of the engine, but as more steam is thrown off from the water at each diminution of pressure, the engine will do a considerable amount of work after the boiler has ceased to receive any heat.

According to Count Rumford a cubic foot of water under 80 pounds steam pressure, and temperature to correspond, contains as much explosive energy as a pound of gunpowder, or the steam which flashes out of the hot water when the pressure is suddenly removed contains as much force as does the gas from the ignited powder. It is not an uncommon boiler that contains 100 cubic feet of water, and indeed in these days of high pressures a very much smaller amount may have the same effect, and yet we allow men to tinker and fool with our boilers that we would not allow to look at the 100 pounds of gunpowder, to which the boilers are equal in power to throw bricks and timbers. After once recognizing this fact we wonder how some so-called engineers and firemen hold either their jobs or their boilers. No intervention of electricity, "furrin" gas or Divine will, is necessary to bring the explosion, but simply a boiler, weak either by construction, wear and tear or bad usage, and, contrary to the conventional cry of the low-waterites, the more water there is in the boiler when it explodes the further the bricks will fly.

To accurately show what takes place in pressure reduction and steam formation while the water is being blown off would require more complicated mathematics than it is the purpose of this article to give. Approximately, however, the solution to your correspondent's question may be suggested.

Suppose 100 cubic feet of water, at an average pressure during blow-off of 60 pounds gage, are to be blown off from a boiler. The steam which replaces the water in the boiler will be evaporated from the water by its own heat as already described, and as the whole amount of water is only in it at the beginning the heat must come from the average amount during blow off, which would be about 50 cubic feet.

To evaporate a cubic foot of steam under the above conditions requires 160.83 units of heat, that being the latent heat of a cubic foot at 60 pounds gage, and 100 cubic feet will accordingly require 16,083 heat units.

A cubic foot of water under above conditions contains 15,983 heat units, and 50 cubic feet are to supply 16,083, or 321.6 per foot. Deducting this from the total 15,983, there remains 15,661.4 heat units per cubic foot, which corresponds with a pressure of about 53½ pounds. This shows that about 6½ pounds reduction in pressure is required to supply steam enough to replace the water where the average pressure during blow-off is 60 pounds. The steam which was in the boiler at the start has, however, fallen an equal amount in pressure, and therefore occupies a larger space rendering a portion of the reduction unnecessary, and there are other causes which affect the final pressure.

This solution shows why removing water to double the steam space does not halve the pressure (it could not halve the *gage* pressure in any case, but, instead, the absolute pressure), and it also incidentally shows some things about boiler explosions, and may indicate a thing or two about the priming of an overworked boiler which those much-advised "young engineers" might do well to bear in mind. Frank Cawley.

Montreal, Canada.

Backing Off Reamers.

Editor American Machinist:

Tecumseh Swift, in his article in American Machinist of September 5th, on "Grinding Reamers and Milling Machine Cutters," says that he does not know of a shop where they grind reamers correctly.

I can mention one, at least, Wm. Sellers & Co., of Philadelphia.

There the cutters are backed off with a convex clearance, and I can vouch for the efficiency of the reamer and the beauty of the finished hole, which, to the touch, was like glass, and appeared polished when looked through.

The reamers were all inserted cutters, three in the smaller sizes and four in larger sizes. The bodies were grooved out and hardened, the shank being ground to a size that would allow it to pass through the hole without shake if reamer was all right, and was a means of detecting if anything was wrong while using them.

The groove in which the cutter was inserted was simply milled out the right width, shallowest at point of reamer and deeper as it advanced toward shank end of reamer. The cutters were fitted after being hardened by grinding, and held by friction on the sides alone.

The reason for making the step in this manner was that, if from any cause a cutter should move from overcrowding or an accidental blow, the size would not be increased but the reverse, and would be noticed at once, for two reasons—if used shank would not enter hole, or one cutter would be seen to not come to end of reamer, it being the practice to grind ends of cutters flush with end of reamer whenever cutters were driven forward or towards end of reamer to expand it when dull.

This reamer was ground by being driven on its own centers, exactly as though it were a solid bar of steel, with the difference that the grinding wheel was moved out and in by a suitable cam at the proper time to give the required clearance.

In that shop everything is reamed, and reamed quickly on the horizontal drills; after a hole is made proper size and given a generous oiling with lard oil (both cast iron and wrought), the reamer is fed through by hand feed as fast as one wants to turn the feed wheel.

The reamers never return to tool room without being sent up to the reamer man for examination if they were only used for one hole.

An experience of several months in the use of the reamers convinced me as to the correctness of the mode of grinding or backing off, and also that they are the best reamers I ever saw anywhere, without exception. E. L. Mills.

Elizabeth, N. J.

The Largest Drop Hammer.

Editor American Machinist:

We note the statement in your issue of September 5th, regarding the large drop hammer built for the Springfield Armory, by the Billings & Spencer Co. This hammer is far from being the largest heretofore built, however, as the following list of some of the heaviest hammers built by us will show. We have built for Douglass Axe Co., East Douglass, Mass., a hammer weighing 1,500 pounds; Beecher Mfg. Co., Meriden, Conn., 1,500 pounds; Tredegar Co., Richmond, Va., 1,500 pounds; J. H. Williams & Co., Brooklyn, N. Y., 2,000 pounds; Snell Cycle Furnishings Co., Toledo, Ohio, 1,500 pounds; Lozier Mfg. Co., 1,500 pounds; Indiana Bicycle Co., Indianapolis, 1,500 pounds; Stanley Rule and Level Works, New Britain, Conn., 1,500 pounds. Here are seven hammers that are 300 pounds heavier than the one you mention, and one that is 800 pounds heavier.

Brooklyn, N. Y. E. W. Bliss Co.

Oiling Bicycle Bearings.

Editor American Machinist:

Noting Mr. Thomas Grant's article in reference to not oiling bicycle bearings, and that of Mr. W. P. Anthony confirming his views, and fearing that many of your readers who ride bicycles may take their advice and fail to give their wheels an occasional oiling, I, as a manufacturer who has watched the construction of probably 50,000 wheels, feel in duty bound to raise my voice against the popular delusion that there is no friction in a ball bearing as applied to bicycles. We are preparing to carry on some experiments with a view of ascertaining the amount of this friction and how it may be best overcome, and shall probably communicate results through your paper.

C. Godfrey Whitaker.

Philadelphia, Pa.

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Men as a Product of Shops.

"We *made* that man, and it's a shame that he should now go off and leave us in this manner."

We quote the words of a shop proprietor who was speaking of a young man that had recently left to better himself after a term of service extending over about six years. The old gentleman was quite honest and sincere, too, in what he said, though it was a fact entirely apparent to anyone at all familiar with the circumstances that the young man had, as machinist and draftsman, simply made himself by hard work at the bench and drawing table during shop hours, and, in some cases, still harder work over books in other hours, and instead of having been "made" by the shop, had, along with a few others of the more intelligent and progressive men about the place, succeeded in keeping it somewhere near up to date, all the while contending against the stupid and narrow-minded conservatism of the proprietor, whose instincts made him oppose everything new, and resist everything that looked like the least deviation from the practice that had been followed there for twenty-five years.

The young man was, as we happened to know, leaving simply because, as he put it, too much of his nerve force and vitality were used up in simply overcoming utterly unreasonable objections to progress, and he was going where he believed there would be fewer hindrances to his work of making himself.

The fact is that men make shops, and they also make what comes out of the shops; shops, their equipment and organization, being only an instrument used by the men in production.

A successful shop proprietor lays down a general plan upon which he proposes to operate his establishment. In carrying out his plans he selects from those who are available the men whom he thinks are best suited for the various positions of responsibility. These men usually owe their selection to something which is within themselves. They are not selected to be made, but because they have, to a greater or less extent, been already made, and are supposed to be capable of assisting in the work of making a shop and its products. They are not usually given more of either money or opportunity for advancement than they show themselves clearly entitled to, and in most cases if advancement is not possible where they are, it will be attained elsewhere—other men will come to recognize their ability, and their success or failure will depend mainly upon themselves, and very little upon others, who may or may not imagine they are making them.

Shop organization has, of course, an influence upon men, and may help or retard their development, but the fact that no one claims to have made a man who is a failure, in itself proves that the degree of success he attains is, by the same token, due primarily and mainly to himself, and the shop proprietor who talks of "making" the successful men who have worked for him, should, to be consistent, also claim to be the maker of the unsuccessful ones, but we never heard of any of them doing it.

Economies That Are Too Small.

An article which has lately gone the rounds of the papers argues and seems to prove that it does not pay to pick up nails that are dropped by a carpenter when busy at his work. His time is worth more than the nails. The value of his whole day's work would be reduced by the picking-up operation to an extent that would not be balanced by the value of the nails saved. But however convincing the argument, it is still a heart-breaking spectacle to some employers to see the nails scattered around. There are many cases of mistaken economy more pronounced than that of picking up nails, and there is no place more likely for them to be found than in the machine shop. Belt laces cost money. When a belt is to be taken up, it may be carefully unlaced and the lace may be used again. The lace is not as good as new if the belt has done any work since the previous lacing, and the lace cannot usually be used again in the same belt, as it will be too short, because the ends necessary to pull it through are usually cut off after each lacing of a joint; still, belt laces cost money and are therefore worth money, and a lace saved is money earned; and we have known a fussy, nagging proprietor when a main belt has slipped off on account of being too slack, and stopped the work of a score of men, insist upon the careful unlacing of the belt and the saving of the laces, although it meant a loss of five or ten minutes to do it.

Files cost money, therefore all the work possible must be got out of them before they are thrown out. Proprietors who kick about their file bills would often make money by kicking their foremen because the file bills are not double as big. Machine tools cost money, therefore they must be used until they are worn out, and they never wear out, and that keeps our shops filled with tools that individually cannot turn out one-half of a day's work, according to the standards of the more advanced tools and processes. Patterns cost money, therefore they must be hung on to until they pay for themselves, and then we are no better satisfied, and they must pay for themselves over and over. Their first making may have been an actual blunder, or they may have been made all right for the time, but only a year may have shown how they might have been vastly improved, still they cost money and they must be used. Nothing contributes more to the decadence of the average shop than the possession of a big stock of old patterns. It costs a pile of money to insure a stock of patterns. If a pattern insurance company could be started that would insure the absolute destruction of every existing pattern more than ten years old, it would be a great benefactor to the mechanical world. That shop is a happy exception that is not lumbered up with a lot of machines or pieces of machinery that have been used for experimental purposes. The thing may have been all right, or it may have lacked just one little idea; still, the remains in either case are now worthless, but they must be kept hanging around for years and years simply because they cost money. If such things must be permitted to still cumber the ground, let the establishment possess a museum, where alone they may be considered sacred and safe from destruction. There is a constant temptation in the general or jobbing shop to work in old material—to *utilize* it. To use a thing is a straightforward and simple operation, but to utilize it is a very different thing. It is not useful, but we contrive to make it useful by cutting and shaping and working it down, or too often by changing our plans from just what we want to what we can just get along with after a considerable sacrifice of time and brains. This idea that things that have cost much money are to be hung on to after they have become utterly worthless runs all through the trade, and only to its hurt. Present or near future values are all that are worth much consideration in the machine shop, and past values are not deserving of consideration. Above all, it should be remembered the constant values of time, space, light, cleanliness, comfort, and whatever interferes with these, however venerable, should be discarded.

The Mechanics of the Brake on the Trolley Car.

We trust that our readers appreciate the efforts we are making, and the success we are achieving in pumping out the facts about the brake on the trolley car from the electrical journals. The *Street Railway Review*, which seems to be the most electrical of them all, in a recent issue electrified its readers with a whole page devoted to the illumination of the above subject. The article referred to is the funniest disquisition that has yet appeared upon this excruciatingly funny topic—the brake on the trolley car. Of course, the article is not funny all through. Only three-quarters of it is distinctively and purposely provocative of cachinnatory explosiveness, while the remaining quarter, by column measurement, is formally announced to be serious. This one-fourth seems to be the proportion of serious consideration to which the subject is fairly entitled in the estimation of our esteemed contemporary.

The first striking thing that we came to in the article is a conundrum, of course. "How is it that motormen invariably have orders to reverse rather than run over a human being?" This is best answered by asking another. How is it that they invariably don't do it? We are told that "reversing is many times harder on the machinery than the quickest brakes in existence." People might not all understand that this is a joke, and it is therefore worth while to look into it a little, so that it may be appreciated. When the motorman reverses he does not reverse the armature at once, he only reverses the current and changes the torque from one direction to the opposite one. If the armature is going, say, at 1,000 revolutions a minute in one direction it does not change and go a thousand revolutions a minute the other way as quickly as he flops the lever over. It takes quite a little time after the current is reversed before the armature is stopped and another period of time before it gets up to speed in the opposite direction. The gearing is, of course, made strong enough for the electrical torque with a large coefficient of safety, and reversing is not in the least dangerous to the gearing. In fact, when the brake is applied to the car wheel, tending to stop its revolution, a reversal of the current on the motor, tending to stop the revolution of the armature, is a positive relief to the gearing, instead of an additional strain upon it. If our contemporary had not put the above assertion as a funny joke, in a funny article, we might have assumed either that it was not informed upon the subject, or that it chose to presume upon the ignorance of its readers, either of which deductions would be painful to contemplate. The poor motorman has not time enough to think usually, and on some cars he would certainly require a third hand, to reverse the motor when applying the brake, otherwise it would relieve the gearing to a certain extent, and also stop the car somewhat quicker to reverse when braking for an emergency. The car, of course, cannot be stopped by the motor alone, as quickly as it can be stopped by the brake alone, so that if both cannot be used, the brake is the more effective. If with the car at rest the full current were turned on, and the car got up to full speed in 150 feet, then with the current reversed it ought to be brought to rest again in about 150 feet, but if with the car at full speed the current were merely shut off, and the brake applied, stopping the car in 30 feet, it is very easy to see how severe must be the strain upon the gearing to overcome the momentum of the armature. It is well enough generally to be consistent even in our jokes, and yet our contemporary further along in the article, still in the funny part of it, acknowledges, in a sentence, which we will reproduce, that electrical engineers long ago recognized this very impossibility of quick stoppage of car wheels and car on account of their being positively geared to a high-speed motor, that they have long been trying, without success, to devise a friction device for driving, and now it begs the mechanics of the country, and even our humble selves, to help them out of their trouble. We submit to our readers whether this is not fairly contained in the following sentence. "If the American Machinist can devise a successful friction-clutch drive for motor cars, he can do more than the many eminent engineers that have worked on the problem up to date."

We are glad at least that our contemporary was able to lay joking aside, even if only for a quarter of its invaluable article, and tell us of the present status and prospects of the brake. We are told that the electricians at first were so busy in showing what wonders they could do with electric

cars, and the speeds at which they could run, that they had not time to think of brakes. When they finally caught on to the idea that a brake would be a good thing on a trolley car, there was no improved brake to be had. "Air brakes began to appear in response to the need, *but their price was high.*" "The past year has seen greater activity along this line than any previous. Improved brakes are coming *slowly but surely*, and with the recent improvements made in all classes of brakes, it is to be expected that *a few years* will see the complete overthrow of the now common hand brake."

Death of a Prominent English Inventor.

Mr. Ralph Hart Tweddell, a prominent inventor and mechanical engineer, died on September 3d, at his residence near Gravesend, England. Mr. Tweddell was born in 1843 at South Shields, where his father, Marshall Tweddell, was, and still is, a ship owner. Young Tweddell prepared to enter the Royal Engineers, but his mechanical bent being so pronounced, he subsequently was apprenticed in 1861 to R. & W. Hawthorne, Newcastle-on-Tyne. Only two years later he invented a hydraulic machine for fixing the tubes into the tube sheets of boilers. Two years later his hydraulic riveting plant followed, and in 1871 he introduced his chief invention of the portable hydraulic riveter. The 650-ton flanging press at Crewe is of his design. This machine, sufficient for locomotive practice, was not powerful enough for marine work of the heaviest class, and what is known as the "step by step" flanging machine was introduced by Mr. Tweddell later. He was a member of the Institutions of Civil Engineers and Mechanical Engineers, and had been a member of the council of the latter society. He received the first Telford medal and also a Telford premium awarded by the Civil Engineers. The cause of Mr. Tweddell's death seems to have been quite similar to that of E. F. C. Davis, president of the American Society of Mechanical Engineers, although the cause and its effect were not close together. A few years ago a horse that he was riding took fright, and jumping over a rotten bank, fell and rolled over the rider. The injury then received resulted in an aneurism which made a cessation of all effort imperative, and the long dreaded cessation of the heart's action ended a useful and honorable career.

Questions and Answers.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet. We cannot undertake to answer questions in "next issue." This department is usually crowded, and questions must wait their turn to be answered. Neither can we undertake to solve mechanical or engineering problems, and send answers by mail.

(359) J. K., Cowanesque, Pa, writes: I have two articles made of brass which are to slide on each other; one is smaller than the other; the only lubricant which can be used is water. What kind of liner can I use on the smaller one to give good results? Could I use glass? *A.*—Glass could be used, but we prefer liners made of lignum-vitæ.

(360) Friction, Fitchburg, Mass., writes: I would like your opinion as to the best shape of thread to use on an elevating screw that carries a heavy load, like a planer beam or boring mill table, in places where a counterweight cannot be used. Will a square thread or a sort of a V-shape like a lead screw of a lathe, run with the least friction? *A.*—We should use a square thread; it will run with least friction.

(361) C. E. K., New York, asks: Are there any self-winding clocks, and if so, how do they work? *A.*—There are no clocks which are, strictly speaking, self-winding, so far as we know. Clocks are in use which periodically make connection with an electric current, which current then winds them, and they are thus kept wound, but the electric current does the winding, and it is only put in operation by the clock itself; so that, strictly speaking, the clock is not self-winding, though it is called the self-winding clock.

(362) E. N., Geneva, N. Y., writes: Please give the safe working pressure for an Adamson flue made of marine steel, ½ inch thick, tensile strength 60,000 pounds per square inch; diameter of flue 52 inches, distance between collapse rings 28½ inches, rings made of 2½x½-inch iron, longitudinal seams riveted with ⅞ rivets. *A.*—First find the safe crushing strength of the flue by the following formula:

$$p = \frac{2\,s\,t}{d} \qquad (A)$$

in which p = pressure per square inch, s = compressive strength of the material, t = thickness of tube, and d = diameter of tube. Assuming the compressive strength equal to the tensile strength, we have 60,000 pounds for the ultimate compressive strength. Since about half the metal is punched away at the rivet joint, and the section of the rivets is only about equal to the net section of the plate, the ultimate compressive strength per unit of length will be about $\frac{60{,}000}{2} = 30{,}000$ pounds per square inch; adopting a factor of safety of 6, the safe working stress per square inch will be $\frac{30{,}000}{6} = 5{,}000$ pounds, which is the value of s in the above formula. Substituting for the symbols in the formula their values we have,

$$p = \frac{2 \times 5{,}000 \times .5}{28.5} = 175 \text{ pounds}$$

per square inch for the safe working pressure. Now apply the following collapse formula based on Fairbairn's formula:

$$p = 3{,}500{,}000\ \frac{t^2}{l\,d} \qquad (B)$$

in which l = distance between centers of collapse rings, the other letters denote the same quantities as before. In both formulæ the dimensions should be taken in inches. If now formula (*A*) gives a lower pressure than formula (*B*), then the former will be the required pressure. Substituting for the symbols in formula (*B*) their values, and making the computation, we find that by formula (*B*) we obtained a much higher working pressure; hence the pressure of 175 pounds as found by formula (*A*) must be taken for the safe working pressure.

(363) X. P., Louisville, Ky., asks: What is the safe thickness for cylinders made of cast-iron, brass, and cast steel for a hydraulic press having a hydraulic pressure of 50,000 pounds on a ram 9 inches diameter? Please give formula worked out in full, and state the factor of safety. *A.*—In cases of this kind we first find the pressure per square inch. The area of a ram 9 inches diameter is 63.61 square inches, hence the pressure per square inch will be

$$50{,}000 \div 63.61 = 786 \text{ pounds.}$$

The thickness of cylinders can now be found by the following formula:

$$t = \frac{p \times r}{s - p} \qquad (1)$$

in which t = thickness in inches of cylinder, p = internal pressure in pounds per square inch, r = inner radius in inches of cylinder, and s = safe working stress in pounds per square inch of metal. The ultimate tensile stress of cast-iron may be taken at 21,000 pounds per square inch; for cast brass, 18,000; and for cast steel 86,100 pounds per square inch. Taking a factor of safety of 3, we have for the safe working stress for cast-iron, $21{,}000 \div 3 = 7{,}000$ pounds per square inch; for cast brass, $18{,}000 \div 3 = 6{,}000$; and for cast steel, $86\,100 \div 3 = 28\,700$ pounds per square inch. Now, substituting in formula (1) for the symbols their values, we have for the thickness of a cast-steel cylinder

$$t = \frac{786 \times 4.5}{28{,}700 - 786} = 0.123 \text{ inch,}$$

say, ⅛ inch for the thickness of the cylinder. For cast-iron we have

$$t = \frac{786 \times 4\,5}{7{,}000 - 786} = 0.553 \text{ inch,}$$

say, $\frac{9}{16}$ inch; and for brass we have

$$t = \frac{786 \times 4.5}{6{,}000 - 786} = 0\,657 \text{ inch,}$$

or $\frac{5}{8}\frac{1}{2}$ inch. Professor Reuleaux in his "Constructor" gives Lame's formula for finding the thickness of cylinder walls as follows:

$$t = \left(\sqrt{\frac{s+p}{s-p}} - 1\right) r \qquad (2)$$

in which the letters denote the same quantities as before. Applying this formula for finding the thickness for the brass cylinder we have

$$t = \left(\sqrt{\frac{6{,}000 + 786}{6{,}000 - 786}} - 1\right) 4.5 = 0{,}63$$

inch for the thickness of the cylinder. We prefer formula (1), it is simpler, and will give safe results. In cases of this kind we should use a factor of safety of not less than 3, as we have done in the above examples.

(364) T. C. K., Dayton, O., writes: Please give a rule for computing the horse-power of a locomotive required to draw a train of cars of a given weight at a given speed. State whether the rule can be used for computing the horse-power required on a level track and for any grade. This question is not limited to steam locomotives; I want to use it for electric and vapor engines. *A.*—To make the process of computation clear we shall take the following example: Find the horse-power required for hauling a train of cars including the tender of the locomotive, the whole weight being 126 tons, the grade is 150 feet per mile, the road having a curve of 716 feet radius on the grade; speed 30 miles per hour. First find the resistance of cars and tender due to rolling and axle friction in pounds by the following rule (*A*): Multiply the weight of cars and tender in tons by 7, the product will be the resistance in pounds.

(*A*) $126 \times 7 = 882$ pounds.

Find the resistance in pounds of cars and tender due to grade by rule (*B*). Multiply the weight of train in tons by the constant .3787 and by the rise of grade in feet per mile, the product will be the required resistance in pounds.

(*B*) $150 \times .3787 \times 126 = 7{,}157.43$ pounds.

Find the resistance of train due to speed by rule (*C*). Multiply the weight of train in tons by the square of the speed in miles per hour and divide the product by the constant 171, the result will be the resistance in pounds due to speed.

(*C*) $\frac{126 \times 30^2}{171} = 663.15$ pounds.

Finally, find the resistance in pounds of train due to curves by rule (*D*). Multiply the number of degrees of curvature by the constant fraction .5 and by the weight of train in tons, the product will be the resistance in pounds due to curves. A curve of 716 feet radius is one of 8 degrees. Hence

(*D*) $8 \times .5 \times 126 = 504$ pounds.

Now adding together all these resistances we have a total resistance of

$A = 882.00$ pounds.
$B = 7{,}157.43$ "
$C = 663.15$ "
$D = 504.00$ "

Total = 9,206 60 pounds.

The speed of the train per minute running at the rate of 30 miles per hour is

$$\frac{30 \times 5{,}280}{60} = 2{,}640 \text{ feet per minute.}$$

The total resistance to be overcome is 9,206.6 pounds, hence the energy expended at the above speed is

$$9{,}206.6 \times 2{,}640 = 24{,}305{,}424 \text{ foot-pounds,}$$

and the horse-power will be

$$\frac{24{,}305{,}424}{33{,}000} = 742.6.$$

This result should be taken as an approximation only, because the coefficient of friction adopted in rule (*A*) may vary, it depends on the degree of smoothness and irregularities of the rails, the different proportions of the wheels and journals, the kind of springs under the cars, the kind and quantity of oil used and other minor conditions. The resistance due to speed depends much on the state of the weather. In calm weather the resistance is less than in strong head-winds, but in what proportion the resistance increases is not accurately known. The resistance due to curves is influenced by many circumstances. It depends on the length of train, whether the cars are empty or loaded, for an empty train will offer a greater resistance than a loaded one of the same weight; by the distance between the wheels under each car, diameter of wheels, shape of tread; by the width of track, its condition, the degree of elevation of the outer rails, and kind of coupling. With so many conditions entering into the solution of a problem, it is easy to be seen that we must depend on experimental data; but very extensive experiments, as far as we know, have not been made, and the results of the computation based on insufficient data at hand must be considered as approximations only, but the results obtained by the foregoing rules will give a fairly close approximation in ordinary practice. For running a train on a straight level track leave out the resistances obtained by rules (*B*) and (*D*), and then proceed as before. For simply starting a train use a coefficient of 8 pounds instead of 7 pounds as given in rule (*A*). The constant .3787 given in rule (*B*) can be used only when the grade is given in feet per mile. When the radius of a curve is given its degree is found by dividing 5,730 by the radius in feet. This is an approximation, but it is sufficiently close for curves over 500 feet radius.

Business Specials

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Gear Wheels, Gear Cutting. Grant; see page 792.

Forming Lathes, Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Patent Solicitor. J. G. D. Mack, Madison, Wis

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

Engrs. should investigate the Korting Condenser. Ootam Catalog from A. Aller, 109 Liberty St., N. Y.

Marine Iron Works, Chicago, builders of steam yachts and marine machinery; catalogs free.

See "Expanding Tool," on page 733, of American Machinist, September 12, 1895.

Squaring and Rotary Shears, Tinsmiths' Tools, Presses and Dies for sheet metal work, are made by the Niagara Stamping and Tool Co., Buffalo, N.Y.

Improved Duplex and Special Gear Cutters in stock and to order; Gear and Milling Cutters of all descriptions. R. M. Clough, Tolland, Conn.

A book useful to engrs. & steam users, "Hawkins' Instructions for the Boiler Room," $2.50. Catalog free. Theo. Audel & Co., 91 Liberty street, N. Y.

When you want brass or aluminum castings, try me once. Twining Campbell, Brass and Aluminum Founder, Machinery Name Plates, etc., Paterson, N. J.

For Sale—"The Process of Cold Tinning as Applied to Tacks, Nails or any Small Goods of Iron, Brass or Steel." Price $5. J. L. Lucas, Lynn, Mass.

"Practical Drawing," by J. G. A. Meyer; used by engineering schools in lieu of text-book; the set of 92 papers sent to any address in the United States for $5. American Machinist, 253 Broadway.

Engineers and firemen: "The Steam User's Guide" answers all questions asked by a board of examining engineers. Price, postpaid, $1.50; 24 p. pamphlet, explaining contents of book, sent on application. C. G. Krell, 13th and Palm Sts., St. Louis, Mo.

Oil Engines.

A man may feel that he has a good knowledge of gas engines, and reason from that that he will not have much to learn about oil engines. Now, as a fact, just as you have to treat a gas engine more tenderly than a steam engine, so must you treat the oil engine more tenderly than the gas engine. I had occasion recently to purchase an oil engine, and I sent with it a certain oil that I had found to do well on a gas engine for the lubrication of the piston. After a few hours' run the engine brought up all standing and full of deposit, and it was not until several different oils had been tried that this fault was cured, and it is obvious that the temperatures in an oil engine must be considerably more severe than in a gas engine to show such a different result with the same class of oil. Trouble with an engine is a fine teacher, and thinking that my own experience may be of use, I will detail it at greater length, for the trouble has not ceased though the quality of the oil has been now secured correct, and the engine runs perfectly. In several varieties of oil engine you start the engine by putting a small quantity of petroleum into a little furnace and blowing up with a rotary blower. This heats a vaporizer contained at the rear of the working cylinder, and when this is hot the engine may be started. This vaporizer is kept hot afterwards by the combustion in the cylinder. If an oil engine is run without load it will stop. It will even stop under a light load in a very aggravating manner. You get to learn this by experience. It seems ridiculous that an engine should be unable to run without load. The reason is simple enough. With a light load there are necessarily many explosions cut out by the governor. This so reduces the generation of heat in the cylinder that the vaporizer is not maintained hot enough to ignite the vaporized oil and the motive power is not produced, and so the engine stops. Thus it is that with an underloaded engine you may see a bar of wood set to press upon the fly-wheel rim in order to compel a sufficient number of explosions to keep up the heat of the vaporizer. I was aware of this peculiarity, but what troubled me was that the engine would run for hours together, and then without the slightest variation of load would stop. It could be started again at once and might run again

for hours before it again stopped. In searching about for a cause, the conclusion was forced on me that the day being hot, and the door of the engine room being left open, the vaporizer was cooled by the draught from the door below the critical temperature of ignition, and that one stoppage at least was thus caused. But since then another thing has shown itself as a probable cause of trouble. The fly wheel caused a strong draught, and, it was evident, cooled one side of the vaporizer. Standing a board so as to prevent this air current blowing towards the vaporizer, enabled the engine to make a long run, and it did not stop again until the board was removed; and I am fixing a permanent wind guard now to try whether I have rightly divined the cause of the stoppages. If so, then it is evident that the vaporizer only needs some protection, such as a bright reflector, to throw back the heat radiated from the vaporizer, in order to cure the trouble at light loads. Clearly the size ot an oil engine must correspond fairly closely with the load to be driven, or the number of idle strokes will be such as to prevent the maintenance of a sufficient temperature in the vaporizer. This constitutes somewhat of a drawback to oil engines, though not an insuperable one. In the case I now refer to, there are three degrees of duty represented by the pumping of water to three different elevations. The maximum duty is by no means too great for the engine, and I anticipate having trouble yet with the lighter lifts. It does not do to allow the vaporizer, on the other hand, to become too hot, or it may lead to too early an explosion of the vapor upon the compressive stroke, the correct temperature being such that ignition of the charge will just take place at the dead point. In heating the vaporizer for starting the engine, if this be made too hot the ignition will not occur correctly, and the engine will run the wrong way round. Ordinarily the oil engine will run round in the direction it is started and may thus be reversed easily, the air inlet and exhaust outlet exchanging duty. If an engine cannot be started as desired, it should be left a short time to cool, as there is risk of straining if the explosion tends to send it the reverse way from what it has been started by hand.

W. H. Booth.

London, Eng.

Continuous and Broken Cutting Edges—Reamer Teeth—Quick Pitch Screw Gear.

By John Randol.

"A little at a time, and that little often," seems to be most decidedly the correct practice for the rapid removing of metal by the use of multi-toothed tools.

Most toolmakers are familiar with the taper-fluted reamer; most toolmakers and tool users have very distinct memories of the good hard work it takes to turn a fluted taper reamer in a piece of soft steel where the hole reamed is over an inch in diameter and two or three inches long; the sight of a big taper reamer at once brings to mind the vision of a substantial tool of the "tap wrench" variety, spliced out with an added two or three feet of iron pipe on each end, and a helper or two, sweaty brows, and possibly a vise pulled away from its fastenings on the bench, or a bench torn loose from the wall; or if the piece in course of reaming is in the lathe and so turned by steam power, there is plenty of stopping and backing up and "oiling the hole," and replacing cone belts and countershaft belts that find it easier to "run off" than to turn the lathe spindle. I wonder if there is a machinist living who does not remember "that tired feeling" which crept over him at the sound of his line shaft belt slapping together as it slid off his countershaft pulley in its vain effort to drive a big chucking reamer cut, and he thought of the shop ladder and the unpleasant climb into the hot and dusty regions overhead?

Quite commonly a roughing taper reamer has a shallow square thread cut along its whole length. This shallow left-hand thread was not, in the old times, cut with any view of breaking up the chip; it did break up the chip, and no doubt the easy cut of reamers

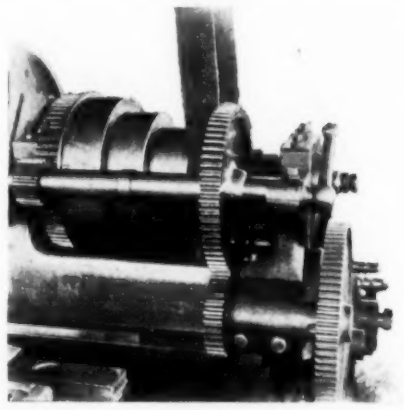


Fig. 4.

so made was, and is, due mainly to the fact that reamer teeth so notched do cut short chips. The idea was, however, that the left-hand pitch of the spiral made the reamer inclined to back out of the hole rather than to "hog in," and bring the job to a sudden stop, including the flop of the driving belt and the unpleasant use of the shop ladder, as previously mentioned. Nobody knows how old this idea of a notched reamer tooth was when Mr. Muir, of Manchester, England, patented it as applied to mill teeth. In a lot of samples sent by Muir to New York, illustrating his practice under his patent, was a small taper-fluted reamer, as reembered, under an inch in diameter, very much more deeply notched with a coarse left-hand square thread than is our American tool-room practice, undoubtedly a good and free cutting tool. Most of the readers of the Machinist are also familiar with the spirally notched teeth of mills used by Brown & Sharpe which have enabled some of their small milling machines to take cuts out of all proportion to their size; cuts two or three or four times as wide as would be expected, with continuous mill teeth, to lie within the capacity of the machine. In this same line of expedient were also the small lengthwise grooves milled in the flats of Farmer's chucking drills, and the stepped ends of another chucking drill, Le Count's, if memory serves correctly. These are some of the thoughts called up by the scene shown in Fig. 1, where four men are taken in the act of reaming two large taper holes at once, in brass. The "tap wrench" is spliced out with pipe extensions, of course. No "super" would ever think of sending an order into the smith shop for a solid wrench as long in the handles as the men who use it know it must be; but with the pipe extensions of the wrench the similarity to common fluted

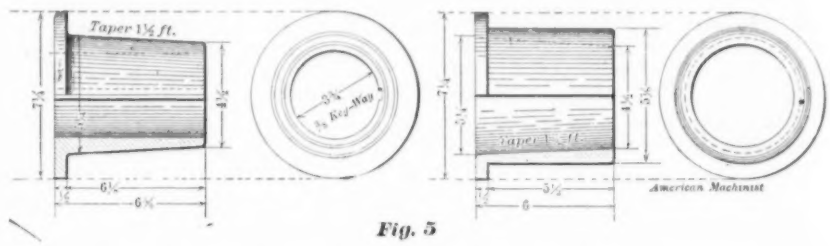


Fig. 5

reamer practice ended; the holes under treatment were large; the actual size and shape is shown in Fig. 5, and a pair of them were being reamed together at the same time, the big taper reamers being splined on the arbor and gradually forced together with a capstan nut on the arbor, seen in Fig. 2. The reaming was in brass of the toughest and "greasiest" description; such metal as the machinist hates to touch, because it cannot be cut with anything short of the hardest and sharpest of tools, but these "gap" tooth reamers took hold with great certainty and uniformity of cut, and showed no disposition to either "slide over" or "run in." It cannot be truthfully said that the cut was easy; the four men on the wrench were exercising their muscles and very distinctly earning their bread by the sweat of their brows, but that four men should turn two of these big taper reamers at once in brass, was sufficient evidence of the vast superiority of the form of reamer tooth shown in Fig. 2.

These teeth are simply the well-known "Ingersoll" inserted tooth, a round body having a length about equal to the diameter, with a short bit projecting above the surface of the cast-iron body into which these teeth are driven. As shown in Fig. 2 some of these mills are fitted with teeth in spiral lines, and some with teeth in straight lines, and some have a great many more teeth than others; with many teeth the spiral tooth setting was said to make the easiest cut, and it was also said that the fewer the teeth in the reamers the easier they cut, and the smoother the work produced. These reamers, as seen at work in the job photographed for the engravings here given, were certainly very superior tools, and they were also extremely cheap tools in the widest and broadest sense of cheapness, as they were not only very low priced as to first cost, but were rapid in action and made good work. An examination of some of these brass bushes in course of being scraped to fit their spindles showed bearings that were very good indeed, and were especially noticeable as being axially correct; that is to say the pair of holes stood in line with each other very fairly before they were touched with the scraper. The holes were round and as smooth as one would care to see.

In Fig. 3 a taper chucking reamer is shown as used in a turret chucking lathe. This reamer was considerably smaller on the point than it appears in the photograph, as the point was nearest the camera, and the camera is a very faithful respecter of the laws of perspective. The reamer is much larger than one would expect to see used with the machine shown; it was working, in cast-iron, very easily indeed.

A large taper reamer made in common form is a very costly tool, and a very uncertain tool as to results; it simply has so much tooth surface that it follows every inequality in the texture of the metal, because the great pressure required to force a long tooth into cut, finds the soft spots in the metal operated upon without fail, and for the same reason any difference in the hardness of the teeth of the mill makes one side shove away from its cut, and forces the other side into cut, and the result is work for the scrapers, plenty of it.

It seems very clear that all cutting tooth lines should be broken up as much as possible. A file might well teach us that lesson, because

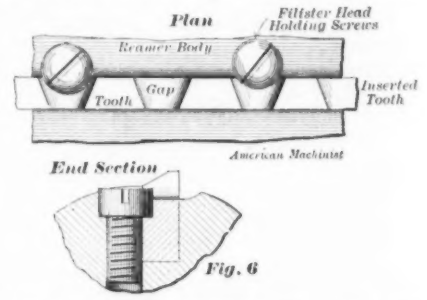


Fig. 6

a file has its teeth, if double or bastard cut, broken up to the final limit, and yet we all know that the file can correct, and does correct all work made with continuous cutting edges. This statement is not novel; it has been made a great many times, but not times enough so that all toolmakers realize its importance. Again, the emery wheel, which, thanks to the general introduction of grinding machines, now finishes so much of our good lathe and planer work, is an assemblage of very small and very hard individual cutting teeth, and is a most pertinent witness to the value of the broken line of cut. In short, there is not the slightest doubt that a continuous cutting edge is a mistake, and a very serious and costly mistake, making tools drive hard and work slow, and produce bad jobs at last, and the wise toolmaker will see to it that his cutting edges are not too many in number, and that they are broken up into as short lengths as the conditions will permit. Probably it can also be safely said that all tools should be made with a view to having the fewest possible number of teeth in action at the same time. Undeniably this statement is correct where truth of work produced is the essential feature of the result; where rapid production is the end sought the multi-toothed cutter is our only resort, and in all cases we must put as little stress as possible on surfaces in course of finishing. The cutting edge must be broken, and must

Fig. 1.

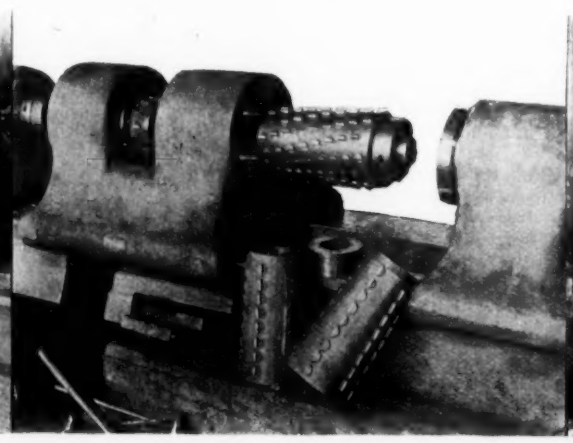


Fig. 2.

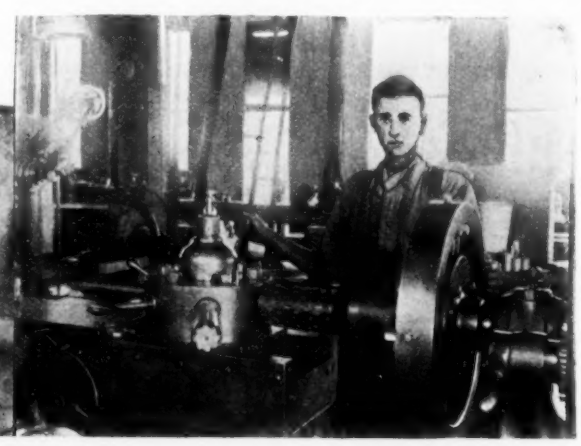


Fig. 3.

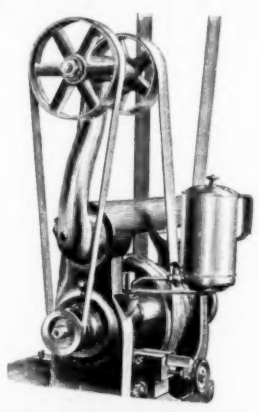
have the smallest length possible in action at one time.

The Ingersoll tooth is patented, and has the advantage of being a regular manufactured article, but the principles apply equally well to other gapped teeth, and they may be made as in Fig. 6, for instance, where, as will be seen, it is only needed to cut 3 or 5 tooth seats in the reamer blank to fit the selected pieces of flat steel forming the 3 or 5 long inserted teeth, which can be "gapped" expeditiously by putting the lot of them into a shaper vise, taking care to stagger them endwise so as to make the teeth "break joints" when the ends stand even with each other in the completed tool; after cutting the notches in the tooth blanks they are slipped into the cuts in the reamer body, and short filister head screws are tapped in close up to the tooth body, the heads being counterbored into the body of the tooth to hold it endwise in its seat in the reamer body; the cutting teeth are then cleared on the sides of the gaps and hardened. It is likely that three teeth will be found quite satisfactory, though a much greater number is common practice, and probably five teeth are all that are needed in any diameter of reamer, circumferentially. Lengthwise the teeth can be as numerous as may be, observing that, as the tooth is well backed up by the body stock, the cutting face of each individual tooth lengthwise, measured from gap to gap, may, if desired, be longer than the thickness of the inserted tooth. In Fig. 6 the filister head holding screws are shown as put in the back, or following side of the inserted tooth; it is possibly better practice to put them on the front side of the tooth. This makes a cheap and good tool.

The shop manager or superintendent is often called upon to make screws of quicker pitch than his lathe gear will give, and is so forced to make a change in the lead-screw drive of a tool. In this case, with our common style of back-geared lathes, the best that can be done is to make the big back gear the first mover; a favorable example of this addition is given in Fig. 4, photographed from the lathe in the Ingersoll shops, on which the quadruple thread milling machine table feed worms are cut. The parts added are very simple, merely a block with a shaft, held with two screws to the back side of the head stock of the lathe; the center of the shaft mounted in this block should come as nearly as possible square under the back gear shaft, so the back gear will lift out of gear all right. The great merit of this scheme lies in the fact that the back gear will stand all the belt can pull, so that the very severe work of pulling the lathe carriage will not result in broken screw gear teeth.

Taper and High-Speed Attachments to Milling Machines.

In our issue of April 18, 1885, there was an illustrated article calling attention to the difficulties connected with milling taper work upon centers in the universal milling

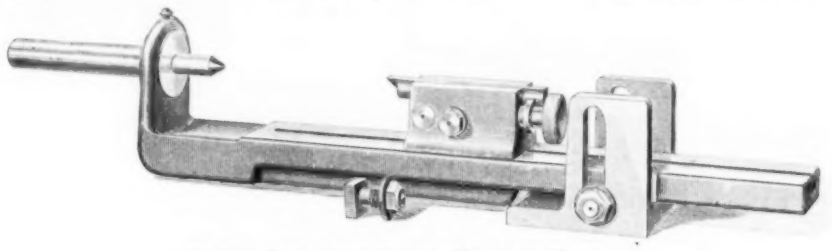


High-Speed Attachment for Milling Machines.

machine, and showing a device for overcoming them.

We illustrate herewith a device for that purpose which, though the same in principle, is an improvement upon the previous arrangement referred to, mainly because it is made more convenient to use.

The device consists of a supplementary platen, upon which is mounted a small foot stock. One end of this platen is supported upon a collar formed upon a center, as shown, while the other is supported by a



Taper Attachment for Milling Machines.

knee bolted to the regular platen of the machine.

When taper work is to be done, the regular head is set to the required elevation, and the center shown is put in place in the head, thus properly locating all the rest of the device, and it is only necessary to tighten the two bolts shown, and the attachment is ready for use.

Taper work held in this way can be readily adjusted to the proper position, can be driven by an ordinary solid dog and is correctly indexed, none of which can be done when the taper is secured by placing the centers out of line with each other. It is made to fit either the No. 1 or No. 2 universal machine, by the builders, Brown & Sharpe Mfg. Co., Providence, R. I.

The same makers are also supplying the high-speed attachment shown.

It consists of a cast arm made to go in place of the overhanging arm, and support the pulleys by which the increase of speed is obtained in the manner indicated. Four steps of the cone pulley being still available for changes of speed in the No. 1 machines and three in the No. 2 machines, the extreme ranges of speed being 342 to 1,537 and 603 to 1,584 revolutions per minute, respectively.

The supplementary spindle runs in a shell which fits the regular taper hole in the spindle of the machine, and by the use of the attachment small stem cutters can be driven at something like an adequate speed, without increasing the feed.

The New Navy Rifle.

An addition to be made to the equipment of the United States Navy will be that of 10,000 Lee straight pull rifles, the caliber of which will be 6 millimeters (.236 inch). The barrels will be made of forged or rolled steel. The steel will be oil-tempered and then annealed, and for 2-inch specimens will have to show an elastic limit of not less than 80,000 pounds to the square inch, and an elongation of not less than 20 per cent. The material will be inspected during manufacture. It is suggested that an open hearth steel which contains 4½ per cent. of nickel will meet the above requirements, and will be preferred, but other steel that will meet the requirements may be used.

The material for the bolts and receivers will be tested physically, and will have to show on 2-inch specimens of standard form an elasticity of at least 40,000 pounds per square inch, with an elongation of 20 per cent. when annealed.

The rifling will consist of six equal grooves, with a uniform twist of one turn in 7½ inches. The depth of the grooves will be .004 inch, and will be similar to those of the Metford rifling.

A model gun will first be made by the contractor, and, if necessary, will afterwards be modified by the Government to meet requirements.

The stocks will be made of the best quality walnut. The butt-stock will be of shotgun pattern with half pistol grip, and the fore stock and barrel cover will be cut away from the barrel so as to be in contact with it only on annular ribs, which will be covered with asbestos.

The butt plate will be of aluminum, checked or roughened, and will have a sliding cover over a pocket in the butt. Yet it is provided that if a steel butt plate can be made sufficiently light and strong it may be used.

The bands will be made of steel, as light as is consistent with proper strength, and will be fastened with screw pins. They will be fitted with swivels for the gun slings and for stacking arms, and the forward band will be fitted with a lug suitable for holding the bayonet.

If a suitable light aluminum bronze can be found, it may be used both for the butt plate and bands.

When finally perfected this rifle will be considered as the model to which all subsequent rifles must gage in every particular.

Meeting of Western Foundrymen's Association.

The recent meeting of the Western Foundrymen's Association, held in Milwaukee beginning September 18th, was a very successful one. There was an attendance of about 70, and papers by H. Hansen and A. Serge, Jr., were read and discussed, the former upon "False Economy in Foundry Equipment," the latter upon "An Example of Cost Sheets for Foundries."

Local foundries were visited, and also the Illinois Steel Co.'s plant at Bay View. The visitors were handsomely treated by Milwaukee citizens, and the meeting was a very pleasant one

Death of an Old Engine Driver.

Joseph Bell, 83 years old, died recently in London, not of old age, but through an accident, having fallen into an open cellarway. Mr. Bell was at one time an engineer of George Stevenson's "Rocket," although not the first engineer, he having been but 17 in 1829 when the "Rocket" made her first trip. Up to within about 18 months of his death, Mr. Bell was an engineer of the London District Railway, showing that the occupation is not incompatible with longevity.

Mr. J. F. Pajeken, superintendent of the shops of Ludw. Loewe & Co., Berlin, and Mr. H. F. L. Orcutt, London, representative of the same establishment, are at present in this country looking about for new tools to form part of the equipment of new shops that the firm will commence the erection of in the spring. Mr. Orcutt, as many of our readers know, is an American, and Mr. Pajeken served an apprenticeship at the Morgan Iron Works, in New York City, but has not been in America before since 1862. Naturally he finds much to interest him here, though he has kept himself in touch with American shop practice by regular reading of the American Machinist, a practice which he says is quite generally followed by all the most progressive men of Germany that are interested in machinery.

The visit of these gentlemen is likely to result in some good orders being left here, and it is possible that even the iron frame work of their shop will be constructed in this country.

Compressed Air for Fog Horns.

The use of steam for blowing the various fog horns so necessary along our coast has always been, and necessarily so, unsatisfactory. When the fog horn is wanted it is wanted badly, and often very suddenly, and when steam is wanted for the fog horn it can only be obtained suddenly by a constant maintenance of fire and pressure. On the New England coast fogs settle down sometimes in five minutes, while it takes from forty-five to sixty minutes to start a fire and raise steam. The fuel cost of maintaining the steam fog horns is considerable. The New York lighthouse district has sixteen fog horns, and some of them require ninety tons of coal a year. The Sandy Hook fog horn last year had 715 hours of fog, and used 94 tons of coal. It costs more to put the coal on the Sandy Hook lightship, close to New York, than to buy the coal. On the western coast there are fog horns at points very difficult of access, and the coal often has to be carried for long distances on the backs of men and mules.

The Lighthouse Board has for the past year been experimenting at the Staten Island station with an entirely new and different fog signal apparatus. Steam and coal are entirely dispensed with. A Hornsby-Akroyd oil engine is used to drive an air compressor, and the compressed air is used instead of steam in the fog horn. A set of the apparatus is to be placed on the Winter Quarter Shoal lightship, off Atlantic City, N. J. Duplicate sets are to be provided as a precaution against disabling accidents. The blast of the horn will last five seconds, and it will be repeated each minute while the fog continues. The sound is said to resemble the snarl of a cat at night, intensified several thousand times. It is conceivable that fog horns of different capacities may be classified according to the cat power of each, just as lamps are measured by candle power. The compressed air receivers are to hold enough air to run the fog horn for ten minutes, while the capacity of the compressor is sufficient to recharge it in five minutes, so that the signal will be always ready, and its action may be kept up indefinitely. The oil used for the engine is used throughout the service for the lamps. The Lighthouse Board buys over half a million gallons a year, and it costs about six cents a gallon, while the engine will use, say, a pint an hour when running. The cost of the oil used in this service is so small that the Lighthouse Board has not taken it into consideration.

The Latest Hyphen Corliss Engine.

An exchange, which it is best not to name, publishes a cut and description of an engine with a plain slide valve and throttling governor as a ———— -Corliss engine. The description says "these engines are similar to the Corliss." In an editorial in our issue of June 22, 1893, we cited the distinctive features of the original Corliss engine as follows: "They were in the form of the bed; in having two steam valves at either end of the cylinder on top, and two exhaust valves at either end below; in its round or cylindrical valves, with their oscillating motion; in its wrist plate motion for actuating these valves; and, finally, in the detaching device for enabling the governor to control the point of cut-off." And we remarked that "Usage seems to have almost justified the application of the name Corliss to any engine which has four valves and an automatic cut-off." But that was two years ago. The above mentioned Corliss has neither the four valves nor the automatic release.

Mr. John D. Riggs, M. E., who was formerly with the Toledo Machine and Tool Co., and for the past year has been instructor in the Mechanical Engineering Department, Lehigh University, has engaged with the New Doty Mfg. Co., of Janesville, Wis., where he will design and superintend the construction of a new line of machinery.

NEW CATALOGS.

There are three sizes of Standard Catalogs, 9" × 12", 6" × 9" and 4½" × 6". We recommend the 6" × 9" size for machinery catalogs. When they must be larger or smaller, one of the other standard sizes should be adopted if possible.

J. A. Fay & Co., Cincinnati, Ohio, issue an illustrated poster of woodworking machinery, with descriptions, which is forwarded to any address on application.

The Gisholt Machine Co., Madison, Wis., have issued a new catalog illustrating and describing

their unique and original turret lathes, and there are in the catalog also a number of fine illustrations of specimens of work made on these machines. The catalog will be found interesting and instructive to those who have to do with manufacturing operations, and is 6″x9¼″.

The Dwight Slate Machine Co., Hartford, Conn., have issued a small catalog devoted to the illustration and description of machine tools made by them. These are chiefly applicable to manufacturing operations, and there is a large variety of them. The catalog will be found interesting to all who are connected with manufacturing operations. It is sent to those interested on application, and is 4″x6¼″.

The J. M. Carpenter Tap and Die Co., Pawtucket, R. I., issue a very fine catalog illustrating and describing various forms of taps, dies and other cutting tools manufactured by them. The catalog is the most elaborate publication of the kind we know of devoted to this line of tools, and contains much valuable information regarding screw threads and their production. It is sent to those interested on application and is standard size, 6″x9″.

We have received from the Hine & Robertson Co., 68 Cortlandt street, New York, a small book entitled, "The Planimeter in a Nutshell." In this book many of the problems encountered by the practical working engineer in handling the planimeter for the first time are treated in an elementary and plain manner, adapted to the use of those who have charge of steam plants, and who have not previously familiarized themselves with such instruments. The book is illustrated by plain engravings, and a special effort has been made to make the principles involved as clear and easily understood as possible. The book has eight pages, and is 4½″x5¾″. It will be found very interesting and useful to most of those who have to do with steam plants, and is sent to any address upon application.

MANUFACTURES

The Lynchburg (Va.) Cotton Mill Co. will shortly erect a machine shop.

It is proposed to erect a cotton-mill at Fayetteville, N. Y., at a cost of $100,000. W. S. Cook is interested.

A new bicycle company has been organized by Robert W. Abbott at New Orleans, La., with a capital of $100,000.

At La Crosse, Wis., the Kuhlman Safety Coupler Co. has been formed with $100,000 capital by Adolph F. Kuhlman and others.

The Onachita Power Co., of Little Rock, Ark., has been incorporated with a capital of $200,000 by J. C. Hunzick and R. Murray.

The Lester Automatic Faucet Co., of Atlanta, Ga., has been formed by A. G. Rhodes and J. K. Polk, with $50,000 capital.

The Wayne (N. C.) Cotton Mills has been organized with a capital of $60,000. Sol. Dewey has been elected president.

The Clifford Manufacturing Co., of Rochester, N. Y., has been organized by Thos. F. Clifford and others, with a capital of $100,000.

The Mississippi Valley Cycle Co., of St. Louis, Mo., has been organized with a capital of $50,000, by Frank J. Kaiser and others.

The Cortland (N. Y.) Forging Co., with $100,000 capital, has been incorporated by David F. Wallace and P. F. Taylor.

A $100,000 stock company will shortly be organized at Yorkville, S. C., to build a cotton-mill. Geo. H. O'Leary is interested.

J. A. Folsom and Chas. L. Wright have organized the Bicycle Keyless Lock Co., of Minneapolis, Minn., with a capital stock of $25,000.

The British-American Ball-Nozzle Co., N. Y. City, has been formed with a capital of $800,000 by James McNiel and Wm. C. Smith.

The Fairfield Cotton Mills has been formed at Winnsboro, S. C., for the purpose of erecting a mill, by W. R. Doty, with $75,000 capital stock.

The Union Phosphate Milling Co., of Portland, Me., has been organized with a capital of $500,000. H. B. McDonald, of New York City, is president.

Are you **SATISFIED** with the many **Practical** articles in the

AMERICAN MACHINIST

this week? **If so,** tell your **friends** about them.

Our discounts to *Club Raisers* are **liberal,** write for them.

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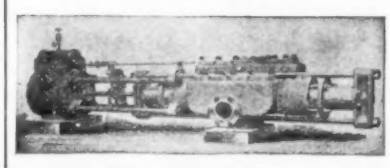

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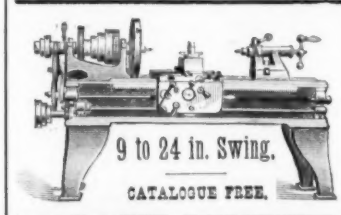

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for a lathe? We are building them in various sizes from 9 in. to 24 in. swing, in various lengths, both engine and speed lathes. Our designs are the **latest,** while the **workmanship, material** and **finish** are of the **highest** order. Our catalogue will tell you all about them as well as of our planers, shapers and other tools.

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It is easy to find the word wanted.
Words are given their correct alphabetical places, each one beginning a paragraph.

It is easy to ascertain the pronunciation.
The pronunciation is shown by the ordinary diacritically marked letters used in the schoolbooks.

It is easy to trace the growth of a word.
The etymologies are full, and the different meanings are given in the order of their development.

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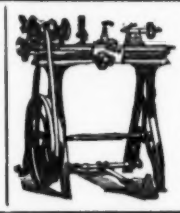

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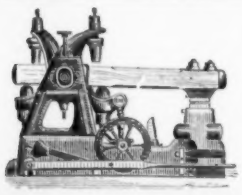

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If you plate, draw, square, taper, swage, collar, spindle, or do any manner of die forging in iron or steel, a Bradley Hammer will soon pay for itself by what it will save over any other similar tool. Helve, Upright and Strap Styles. Send for circulars.
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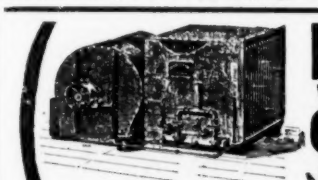

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87 MAIDEN LANE, N. Y. JERSEY CITY, CHICAGO, PHILADELPHIA, BOSTON, LONDON

The Kearney & Foot Co. announce that owing to increased cost of materials and inability to fill orders promptly prices of their files will be advanced October 1st.

The Smith & Thayer Co., of Portland, Me., has been formed to manufacture steam boilers, pumps, etc., with $37,500 capital stock. W. H. Thayer is president.

The Southern Cycle Co., Limited, of New Orleans, La., has been incorporated to erect a plant for manufacturing bicycles, by Charles E. Fenner and others, with a capital stock of $50,000.

The U. S. Navy Yard, Brooklyn, are making some extensive additions to their machine shop department, and have just awarded a contract to The Lodge & Davis Machine Tool Co., of Cincinnati, Ohio, for several heavy engine lathes.

The Springfield Machine Tool Co., Springfield, Ohio, have brought out a 14-inch engine lathe of the "Springfield-Muller" pattern, the general design of which is the same as the larger lathe illustrated in our issue of December 6, 1894.

It is announced that the co-partnership heretofore existing at Painted Post, N. Y., between Abijah Weston, F. E. Bronson and C. K. Longenecker, has been dissolved by the retirement of Mr. Longenecker. The business is to be continued under the same firm name by Messrs. Weston and Bronson, who assume all liabilities.

The Gouverneur Machine Company, of Gouverneur, N. Y., has failed. The First National Bank, which held chattel mortgages, causing its failure, has so arranged that the shop will continue to run for the present, and all orders will be filled. It is understood that a new company will be formed to rearrange and re-stock the plant, and that the business will be continued.

The new machine shop for The Granger Foundry and Machine Co., at Providence, R. I., will be one of the largest and most complete in the New England States. The building is designed and built by The Berlin Iron Bridge Co., of East Berlin, Conn., and is 110 feet wide by 306 feet long. The construction is similar to the Fuller Iron Works' machine shop, designed by the same parties, and which has been before illustrated in these columns.

The Berlin Iron Bridge Co., of East Berlin, Conn., have just completed for the Geo. W. Stafford Mfg. Co., Providence, R. I., a new machine shop 50 feet wide and 174 feet long, two stories high. The building is constructed of brick and iron and is so designed that two additional stories may be added in the future. The same company have also just completed a new car barn for the New Haven Street Railway Co., the barn being 86 feet wide and 188 feet long. The roof is covered with slate.

The Peoria Rubber and Mfg. Co., of Peoria, Ill., have formed a corporation with a capital stock of $200 000 for the purpose of manufacturing bicycles. They are now erecting new buildings, and will be ready for operation within the course of 60 or 90 days. They have placed their order with The Lodge & Davis Machine Tool Co., of Cincinnati, Ohio, for the entire equipment of the plant, including engine lathes, milling machines, shapers, drills, screw machines, hub machines, etc.

A handsome excursion steam yacht has just been completed for Wm. Zink & Co., of St. Louis, by the Marine Iron Works, of Chicago, in which they have placed one of their 8x8 balanced piston valve high-speed marine engines; boiler allowed 165 pounds working steam pressure. The yacht is 50 feet long on deck, 10½ feet beam, draws 3 feet of water, has flush deck and is licensed to carry 75 passengers. Delivery will be made under her own steam via Illinois and Michigan Canal and the Illinois and Mississippi Rivers.

As an evidence of the increasing prosperity among railroads and those engaged in the manufacture of railroad rolling stock, J. A. Fay & Co., the manufacturers of car and railway woodworking machinery, report an increasing business in this line. They are now furnishing machinery for the Mexican International Railroad Co., the Illinois Central Railroad for their new shops at Burnside, Ill., the Queen & Crescent and the Big Four Railroads, Missouri Pacific Railway Co., Jacksonville, St. Augustine & Indian River Railway, and have recently equipped the new shops for the B & O. S. W., at Washington, Ind., Pittsburg & Lake Erie Railroad Co., Kansas City & Gulf Rail oad, Mobile & Birmingham Railroad Co., Lenoir Car Co., at Lenoir City, Tenn., New York Central for their Utica shops, and a number of others. They anticipate an increased trade in this direction for some time to come.

The Jones & Lamson Co., Springfield, Vt., write us: Among the recent shipments of our 2x24 flat turret lathes, we hand you the following names: Cheney Bros., South Manchester, Conn.; Dwight Slate Machine Co., Hartford, Conn.; Wm. Sellers & Co., Philadelphia; M. Koyemann, Dusseldorf, Germany; Woonsocket Machine and Press Co., Woonsocket, R. I.; Ramapo Iron Works, Hillburn, N. Y.; Fairbanks, Morse & Co., Beloit, Wis.; The Aermotor Co., Chicago; National Switch and Signal Co., Erie, Pa.; Filer & Stowell Co., Milwaukee, Wis.; Howard & Bullough American Machine Co., Pawtucket, R. I. We are also preparing a carload of high turret screw machines for the Indiana Bicycle Co., Indianapolis, Ind., and are being greatly pressed with orders for these tools from bicycle builders. We have all the business we can handle with our present force, consisting of 130 men, and are making arrangements for greatly increasing our output.

Machinists' Supplies and Iron.

NEW YORK, September 28, 1895.

Iron—American Pig—We quote standard Northern brands, $14 to $14.50 for No. 1; $13 to 13.50c. for No. 2; $12.75 to $13.25 for No. 2 Plain, and $12.50 to $13 for Gray Forge. Southern brands, $14 for No. 1; $13.50 to $14.75 for No. 2; $13 to $13.50 for No. 3; $13.50 to $14 for No. 1 soft; $13 to $13.50 for No. 2 soft; and $12.70 to $12.75 for Foundry No. 4.

Antimony—Prices are somewhat easier. Cookson's is quoted at 8c.; Hallett's, 7½c.; Japanese, 6⅞c. to 7c.

Lard Oil—Prime City is quoted at 50c. to 51c.

Copper—The market is quiet; small lots of Lake Copper have been sold at 12c. Casting Copper is held at 11⅝c. to 11¾c.

Lead—The market is dull, but prices have not been affected much, 3.32½c. to 3.35c. are quoted.

Spelter—The market is quiet and the demand light. Sellers are holding out for 4.35c. to 4.40c.

Tin—The market is without vigor; not many new purchases by consumers have been made, although deliveries on old contracts have been fairly large. About 14.35c. for round lots seems to be a fair quotation.

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

TO SUBSCRIBERS.

On and after July 4th this paper will give two free insertions under this heading to those in want of positions. The advertisement to occupy a space of not more than five lines. Additional space or insertions must be paid for in advance at regular rates.

Wanted—Bright, active machinists to canvass for subscription to AMERICAN MACHINIST, liberal commission. Address, with refs., Subscription Dep't, AMERICAN MACHINIST, 203 Broadway, N. Y.

Draftsman, young man, wants pos.; last employed in designing pumps. Box 130, AMER. MACHINIST.

Practical draftsman desires position; N. Y. City preferred. H. D., care AMERICAN MACHINIST.

General machinist, 15 years' experience, erector, repairer; spec'y steam engines. Box 130, AM. MACH.

Pos. wanted as supt., exp'd on Corliss eng's, mill, heavy, gen. mach'y and electrical work; middle aged, good manager, J. L., AMERICAN MACHINIST.

Wanted—A draftsman on Corliss engine work; must be a specialist and capable of leading the work. Sparrow's Point, Md., Maryland Steel Co.

Engineer, designer and salesman, well posted in steam pumping machinery, single and duplex, is open for an engagement. Box 129, AM. MACHINST.

Wanted—Situation as superintendent of brass works; long experience in all departments. Box 113, AMERICAN MACHINIST.

Wanted—Exp'd mech. draftsmen with spare time evenings; state present position. Edwin Guthrie, Corcoran Bldg., Washington, D. C.

Man of 12 years' exp. wants responsible position as draftsman, salesman, or in charge of shop. Box 127, AMERICAN MACHINIST.

Competent draftsman wants position; ten years' experience in mechanical and electrical designing; ideas developed from sketches and instructions. Box 122, AMERICAN MACHINIST.

Wanted—Position by a first-class planer hand, quick and accurate; large work preferred. Address Box 128, care AMERICAN MACHINIST.

Wanted—A first-class designer and patternmaker, also A1 machinist as foreman of shop doing light fine work west of the Mississippi. Address M B., care of AMERICAN MACHINIST.

Young mech. engr. and steam engine expert, would like to correspond with parties needing some one to do testing and adjusting after October 15. Address Box 125, AMERICAN MACHINIST.

Draftsman machinist or accountant competent to manage small paying plant, can have an interest and position on favorable terms; must have some cash or collateral. Address Sparta, AMERICAN MACHINIST.

Competent machinist (33), 10 years' experience on jobbing and repair work, with good executive ability, wants a situation in small shop or to take charge of repair work in manufacturing concern. Address W. J., AMERICAN MACHINIST.

Young man (21), three years in one of best technical schools, wants position, either drafting or other work, with some reliable firm; good references; anxious to get a start; wages not object. Knight, AMERICAN MACHINIST.

(*Continued on Page* 794.)

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No.	INCH.	PRICE.	No.	INCH.	PRICE
1	⅜	$ .35	8	2	$1.10
2	½	.35	Small set of 8—5.50		
3	¾	.50	9	2½	1.40
4	1	.60	10	3	1.50
5	1¼	.75	11	3½	1.70
6	1½	.85	12	4	1.90
7	1¾	1.00	Full set of 12—12.00		

C. W. LeCOUNT, South Norwalk, Conn.

These goods are for sale by CHAS. CHURCHILL & CO., L't'd, 21 Cross St., London, England.

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SPECIAL TOOLS.
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TO ORDER.
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Tensile strength of ten specimens taken from an air furnace heat:

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36,420 "	34,650 "	32,460 "	36,550 "	36,700 "

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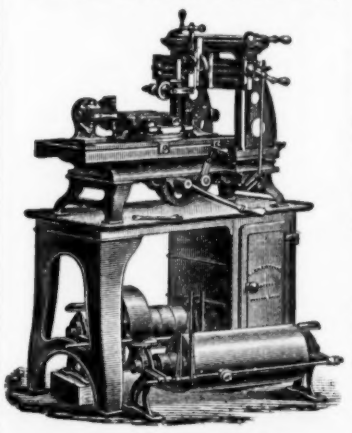

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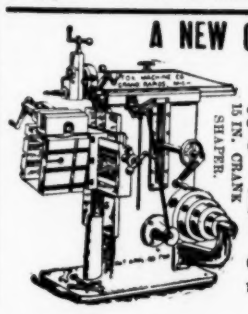

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Advertisements will be inserted under this head at 25 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd lathes & planers. S.M.York, Clev'd, O.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

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For Sale—A first-class key-seater, new. Address Mitts & Merrill, 913 Tilden St., Saginaw, Mich.

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Wanted—A purchaser for a good key-seater, by Mitts & Merrill, 913 Tilden Street, Saginaw, Mich.

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Wanted—To correspond with any one in need of a first-class key-seater. Address Mitts & Merrill, No. 913 Tilden Street, Saginaw, Mich.

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For Sale—A foundry and machine shop together, with steam engine and boiler, also shafting in the same; plant is located 30 miles from Chicago on the Outer Belt Line which connects with all railroads entering Chicago. Address J. P., American Machinist.

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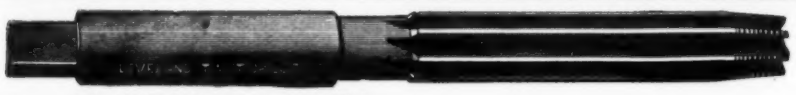

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" " Pond, 20 in. x 15 ft., Extra Heavy A1.
" " Harrington, 20x10 ft., Compound Rest, Cross Feed
" " Fay & Scott, 36x18 ft., Compound Rest, Cross Feed.
" " Fifield, 40 x 10 ft., Compound Rest, Cross Feed
" " Union, 72 x 20 ft., Triple Geared, Screw Feed.

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" Fitchburg, 27 x 8 ft., Automatic Feeds.
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" Betts, 36 x 12 ft., Heavy Pattern.
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" " Lincoln Pattern Millers with Vises.

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1 16 in. x 8 ft. Flather.
2 18 in. x 8 ft. Flather & Prentice.
3 18 in. x 8 ft. Lodge & Davis.
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1 27 in. x 10 ft. Dustin.
1 28 in. x 12 ft. Blaisdell.
2 30 in. x 14 ft. Lincoln.
1 32 in. x 15 ft. Bement Triple Geared.
1 22 in. x 10 ft. Niles.
1 24 in. x 10 ft. Niles.
1 79 in. Driving Wheel, Bement.
1 48 in. x 18 ft. Gay & Silver.

PLANERS.

3 48 in. x 32 in. x 6 ft. Pond, two heads.
1 48 in. x 32 in. x 8 ft. Pond, two heads.
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1 32 in. x 10 ft. Open Side.
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3 22 in. Back Geared.
2 25 in. " & P. F., Snyder.
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1 No. 1 B. & Sharpe.
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MISCELLANEOUS.

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28 in. x 20 ft. Perkins.
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PLANERS.

16 in. x 16 in. x 4 ft. Hendey.
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12 in. Juengst, Crank.
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6 Spindle Quint. Turret.
No. 2 Three Spindle, Garvin.
No. 2 Four Spindle, Pratt & W.

DRILL PRESSES.

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24 in. Aurora, Back Geared.
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No. 00 Garvin, Wire Feed.
No. 5 Brown & Sharpe.
No. 1 Garvin, Plain.
No. 2 Garvin, Plain.
16 in. x 5 ft. Reed Chucking Lathe.

MILLING MACHINES.

4 No. 2 Pratt & Whitney, Lincoln.
1 No. 20 Garvin, with arm.
1 No. 2 Garvin, Plain
No. 0 Garvin Universal.
No. 1 Garvin Universal.
No. 2 Garvin Duplex.
No. 1 Garvin Hand.
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24 in. Pratt & Whitney Vertical Drilling Machine.

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1 40 in. x 60 in. x 16 ft. New Haven Iron Planer.
1 32 in. x 32 in. x 10 ft. D. W. Pond " (Two Heads).
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1 14 in. x 16 in. x 15 in. Blaisdell Crank Planer.
1 16 in. x 16 in. x 12 in. Whitcomb " "
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1 Four-Spindle " " "
1 Six-Spindle Quint Turret Drill.
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29 " 13¼ " " "
26 " 20 " " "
29 " 12 " " "
37 " 30 " " "
71 " 18 " " "
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Portable Drill.
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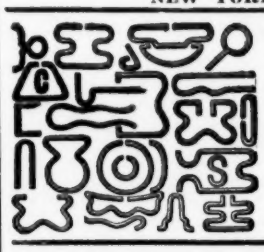

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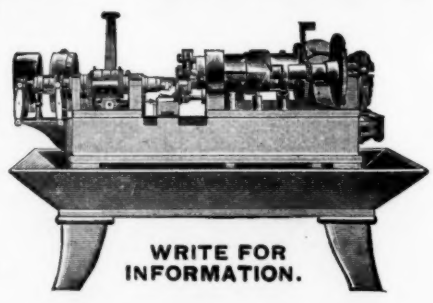

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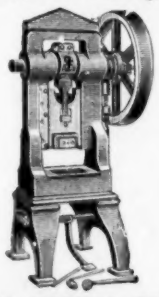

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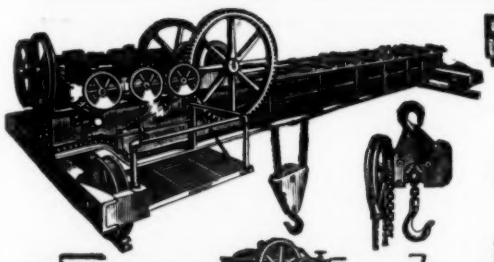

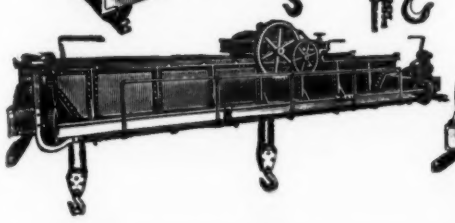

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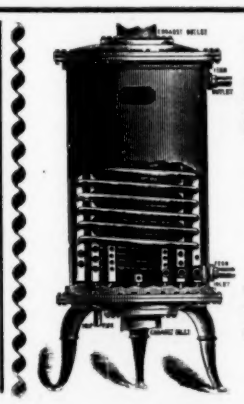

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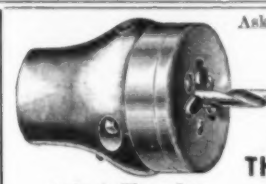

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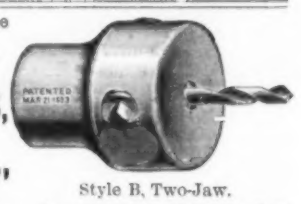

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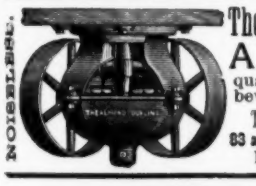

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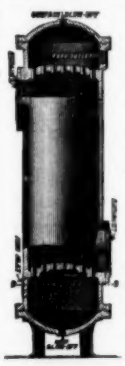

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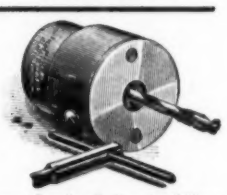

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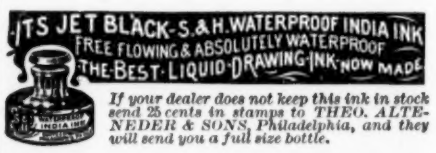

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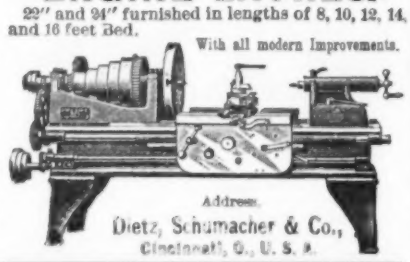

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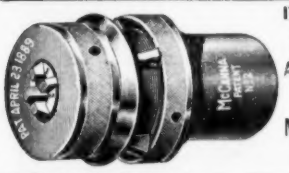

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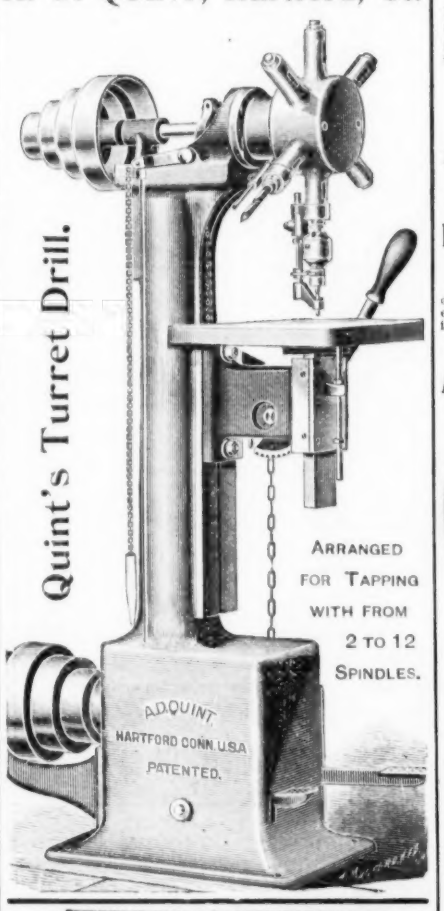

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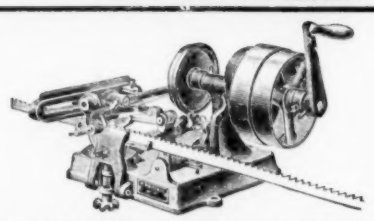

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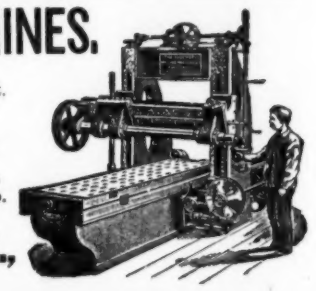

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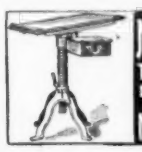

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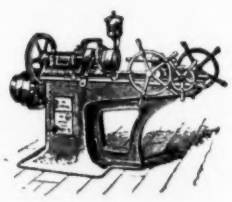

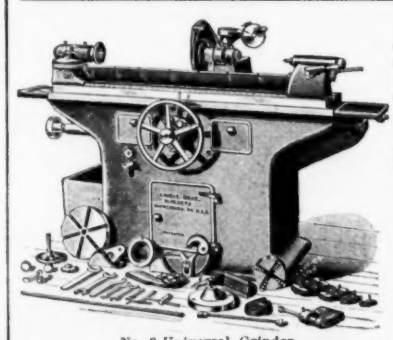

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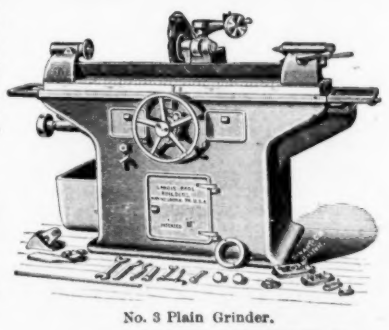

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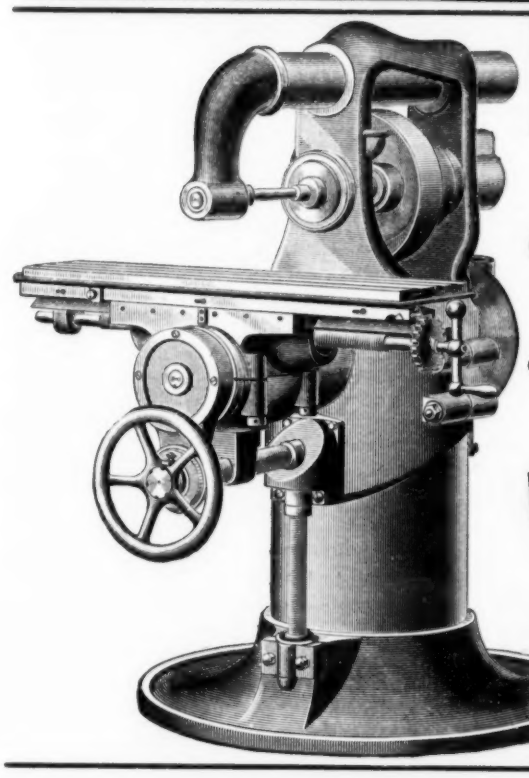

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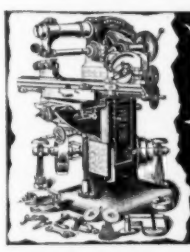

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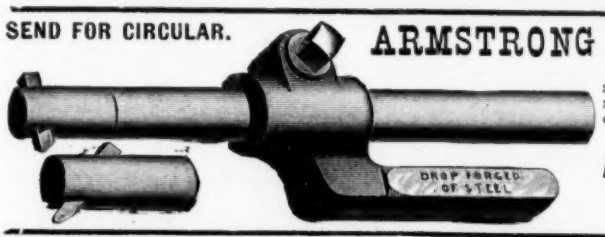

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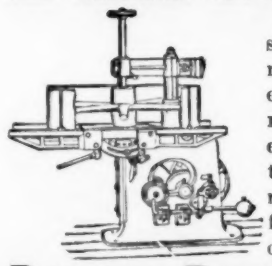

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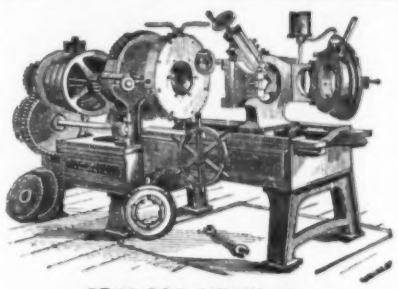

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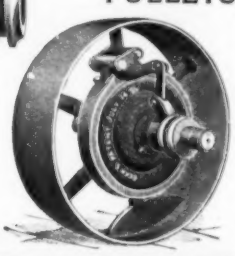

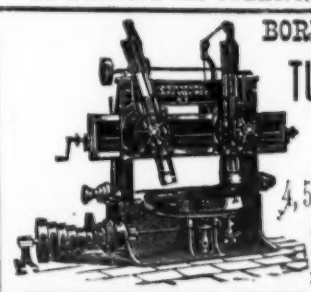

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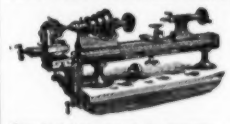

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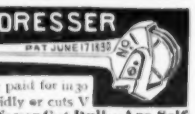

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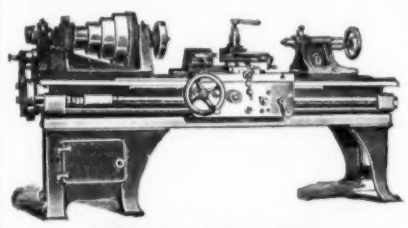

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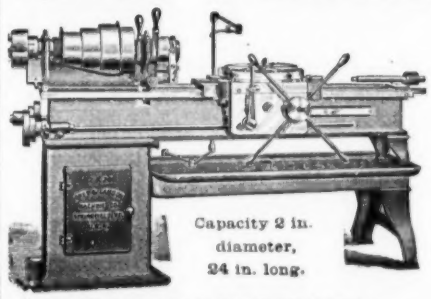

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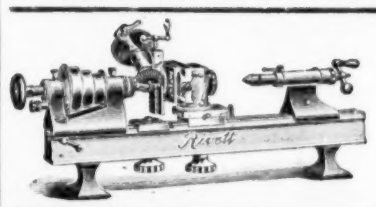

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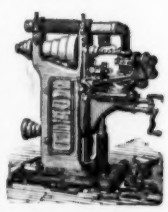

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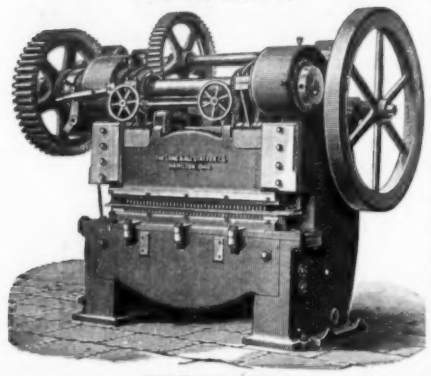

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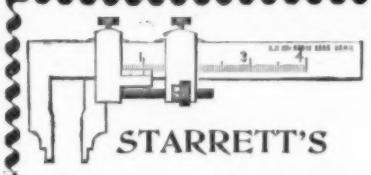

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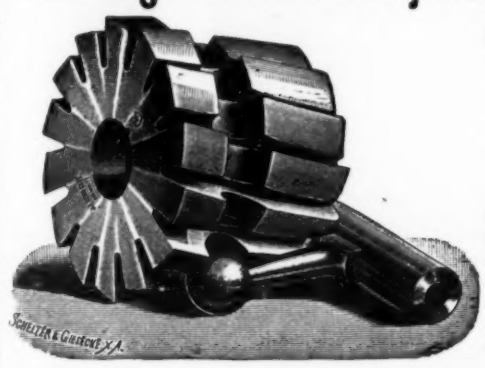

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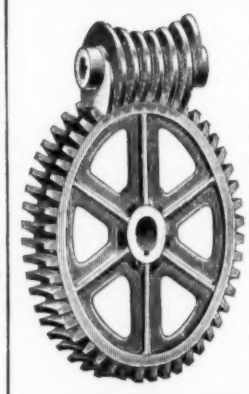

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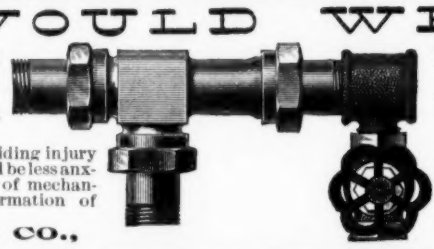

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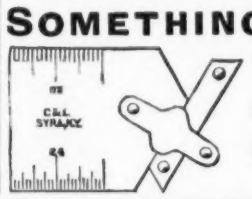

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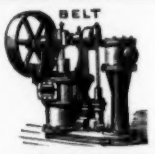

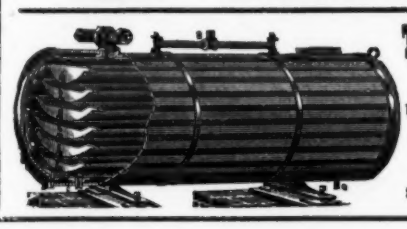

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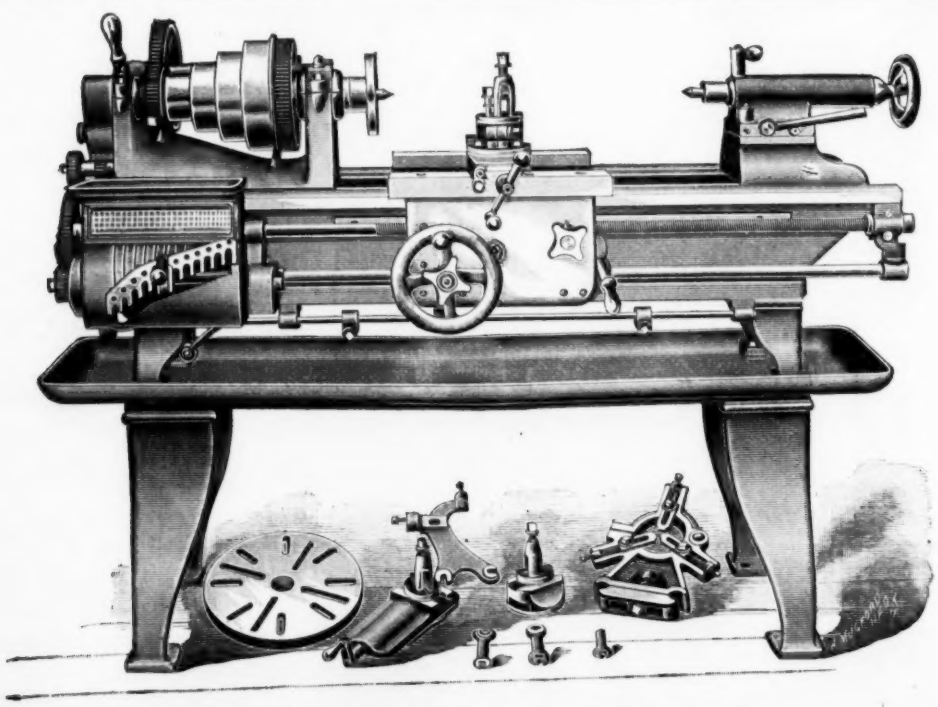

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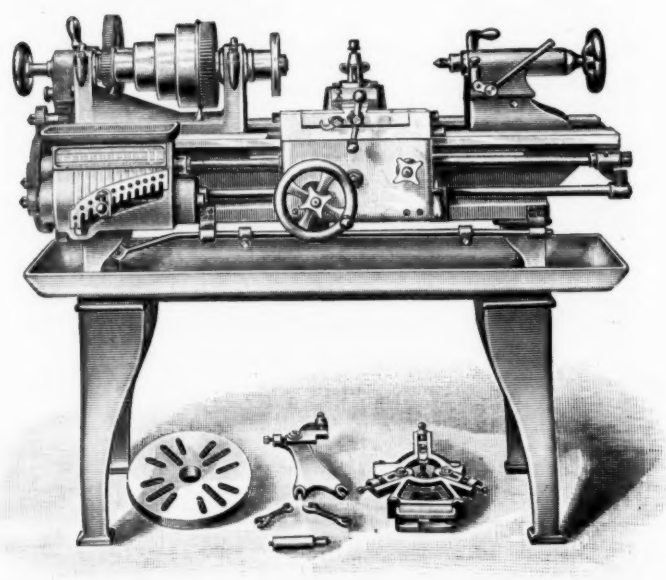

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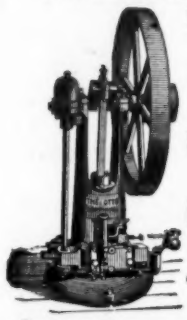

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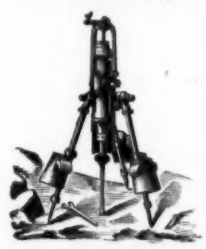

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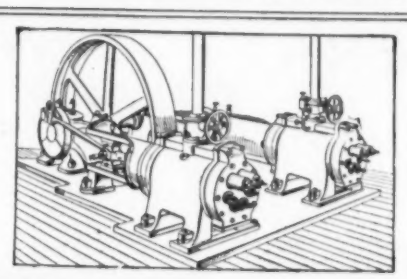

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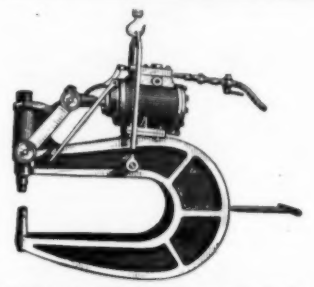

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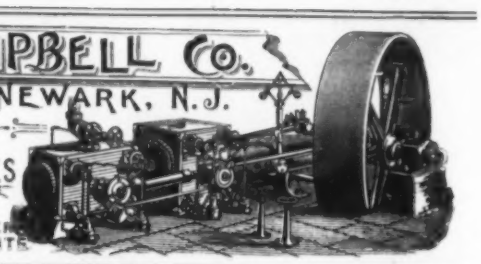

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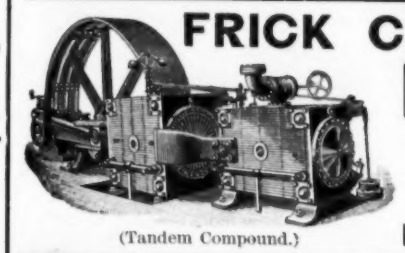

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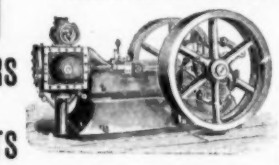

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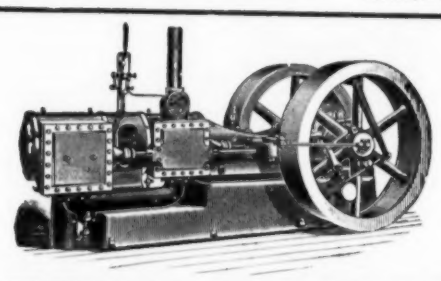

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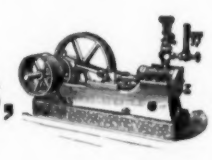

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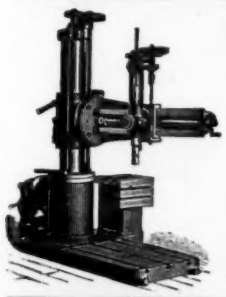

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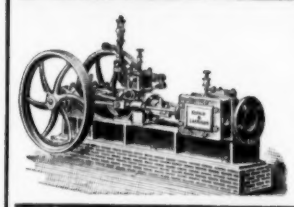

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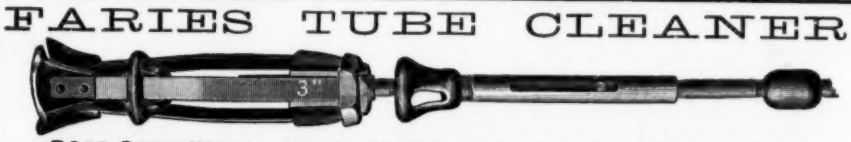

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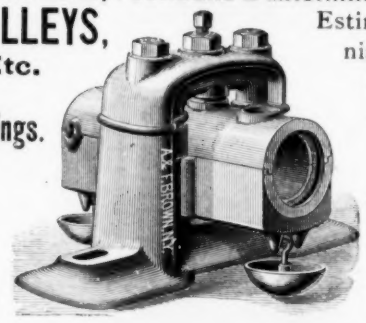

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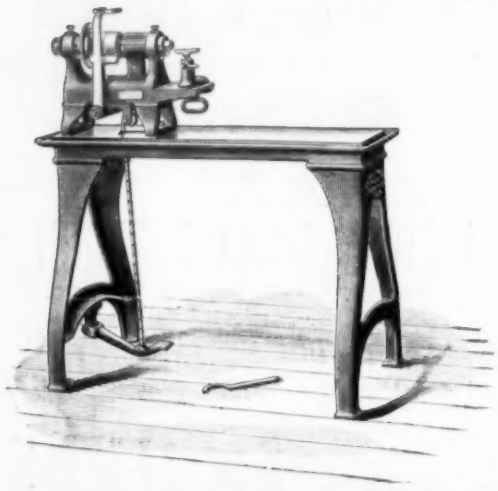

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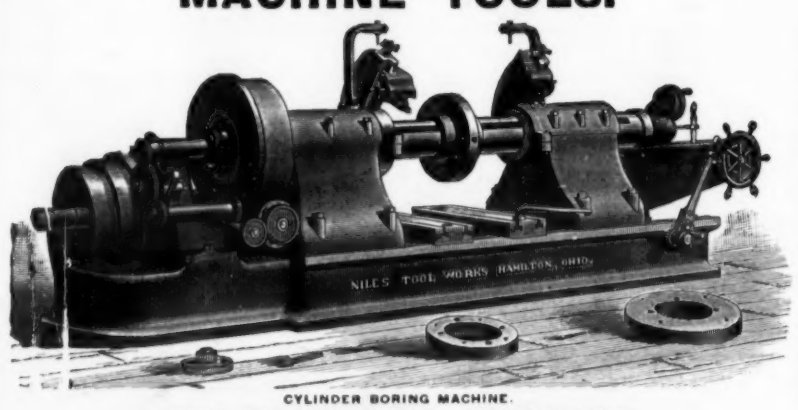

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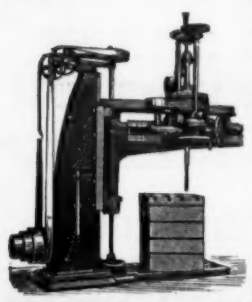

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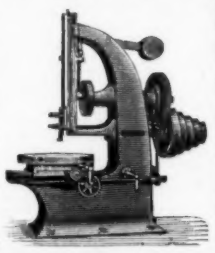

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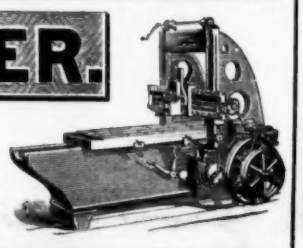

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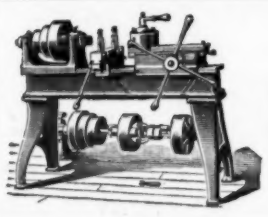

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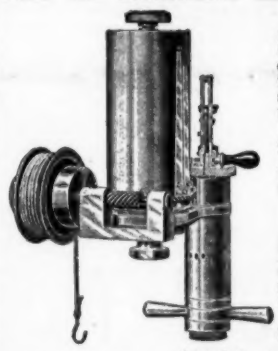

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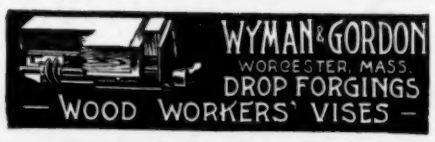

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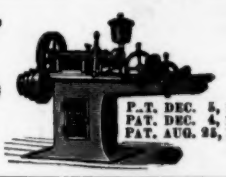

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